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ILLUMINATING ENGINEERING

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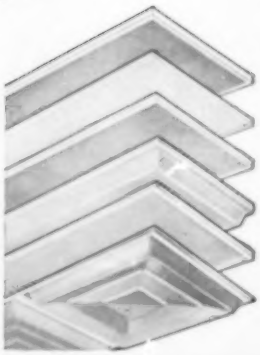

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ILLUMINATING ENGINEERING

THE JOURNAL OF THE ILLUMINATING ENGINEERING SOCIETY

September 1958

Vol. LIII, No. 9

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STATEMENTS and opinions in articles and papers in ILLUMINATING ENGINEERING are the expressions of contributors and do not necessarily represent the policies or opinions of the Society. Official Society opinions are expressed only in official committee reports specifically approved by the Council of the Illuminating Engineering Society.

ILLUMINATING ENGINEERING SOCIETY

EDITORIAL and advertising offices
1860 Broadway, New York 23, N.Y.

PUBLICATION office 32d Street & Elm Avenue, Baltimore 11, Md.

Founded 1906

ILLUMINATING ENGINEERING: The Journal of the Illuminating Engineering Society. Copyright 1958 by the Illuminating Engineering Society. Published monthly in the United States of America. Entered as second-class matter at the Post Office, Baltimore, Md. Acceptance for mailing at special postage rates provided for in Section 1103 P.L.&R., Act of October 3, 1917. Authorized July 16, 1918. ¶ Subscription $18 per year plus extra postage to all countries to which second-class postage rates do not apply; single copies $1.50. ¶ Address changes must be received at I.E.S. headquarters by the first of the month to be effective with the issue of the next succeeding month.

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For making important decisions . . . for receiving important guests, this top executive panelled office at Holliston Mills has been functionally planned and equipped. It and the conference room (small photo) are part of a newly remodelled, two-story office building and are a tribute to the architects.

Litecontrol luminous ceilings are used in most of the private offices on the second floor. An unusual feature is the mounting of the ceilings at a slight (5°) angle. They slope downward from the window wall to the inside wall.

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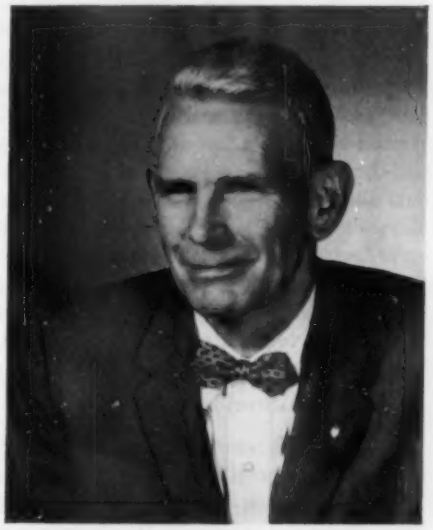
President's Report

By KIRK M. REID
President, 1957-1958



ONE OF THE Constitutional revisions which you recently approved permits holding the Society's Annual Corporate Meeting at any time and place designated by Council. At its June meeting, Council voted to hold the meeting in Toronto, as a feature of the opening session of the 1958 National Technical Conference. The Annual Corporate Meeting of IES is now in session.

Perhaps everyone is not aware that our Society has been holding Annual Corporate Meetings. The records indicate that such meetings have been held every year, for over 50 years — since the Society was founded in 1906. Our Constitution, as *formerly* worded, required that the Annual Corporate Meeting be held on the second Thursday in October of each year at a place in the State of New York designated by Council. During recent years, attendance has been limited to a faithful few. Their sole business at these meetings has been to vote acceptance, for the official Society records, of Council actions during the preceding year and of the Officers' reports as presented at the National Conference. That was all.

This sort of legal formality is quite foreign to the democratic procedures of our Society and of our two countries. Under the revised procedures we have the opportunity at this year's meeting for a large gathering of interested members. Your Officers will attempt to do justice to the occasion. We will attempt to give you a condensed but adequate report of our stewardship during the fiscal year 1957-1958. Then we invite your comments and questions, your criticism of our past actions if you so desire, and your guidance during the year to come.

An Address presented at the National Technical Conference of the Illuminating Engineering Society, August 17, 1958, Toronto, Ont.

The first report this morning will be mine, as President. My comments will deal broadly with the state of the Society and with major developments of the year. Next, R. G. Slauer, our General Secretary, will give you the key facts of the year's growth and activities. Under our present organization he is the *business* manager of our Society. Then, George Taylor will highlight the accomplishments of the past year in our *technical* program. That program has been under his executive direction as our First Vice-President. And what a gratifying, thrilling story that is! He will also say something, as our President-Elect, of his plans and objectives for the year to come.

A Growing Society

Now for my President's Report. Our IES is growing — in many respects. This year we have had a *net* growth of about 300 individual memberships, for a total close to 9000 — our all-time high. We have installed four new Chapters, and one new Section, at Newark, N. J., making a total of 82 Sections and Chapters, 82 areas of IES influence.

We have continued our growth in technical stature. Currently we have 41 Emeritus Members and Fellows, revered patriarchs of lighting. We have 113 Fellows, the "PhD's" of our Society. And we have 2410 full Members, the "Master Craftsmen" of IES.

We are growing in the effectiveness of our technical program. We are steadily increasing the extent and authoritativeness of new knowledge upon

which our technical program is based—new knowledge of the ways light affects human behavior, human beings. This is George Taylor's story.

We are growing in the effectiveness of our local activities, our Section and Chapter programs. Our magazine, ILLUMINATING ENGINEERING, is getting ever better; let me remind you that in winning an Award of Merit last year, it was judged tops among 653 professional magazines. Financially, we are just about on solid ground, although not exactly on Easy Street, as Dick Slauer's figures will indicate.

In short, IES is growing in over-all service to its members and to the lighting industry, and to the *allied* industries and professions that contribute so importantly to the attainment of our Society goals.

Revised Constitution

In my introductory remarks I made reference to our revised Constitution. Perhaps unnecessarily, let me remind you that these revisions introduce *no* basic changes whatever in the objectives or organization or procedures of our Society. The Founding Fathers who wrote the original Constitution, over a half-century ago, gave us an amazingly enduring document. The revision did comprise clarifications and modifications keyed to the present size and activities of our Society.

The revisions also sought to confine to the Constitution matters of organization and policy, leaving details of procedure to the By-Laws. As you know, the By-Laws may be changed by action of Council, whereas a ballot vote by the Society membership is required to change the Constitution. Hence, it is proper to put into the By-Laws details of procedure which may need revision from time to time as we grow and undertake new activities.

In anticipation of a question, the recent revision of the Constitution does require a companion revision of the By-Laws. That work is far along. It is one of the most painstaking jobs — as well as one of the most important — in our Society. Further, the job is of such a nature that the participants receive little recognition for their labors. Therefore, let me express our indebtedness to Past-President R. F. Hartenstein, to Treasurer-Elect Frank Dean, to Past-President Walter Sturrock, to former Regional Vice-President Lester Twichell, and to several others who have rendered valuable consultation on this work.

Headquarters Location

For many years there have been periodic discussions about the best location for our Society Headquarters. We have received suggestions that we consider half-a-dozen cities other than New York, each with certain advantages and inducements. We have also received suggestions that we consider a Headquarters location attached to some University Campus, with associated cultural and research advantages. These have been good suggestions, worthy of careful study.

Our Advance Planning Committee recommended that such a study be made, and outlined considerations to be taken into account. This matter has been further brought to a head by the recent study by five major engineering societies of the best location for *their* headquarters. After an exhaustive analysis of all related factors, by outside consultants, that group decided to remain in New York City. They also decided to build a United Engineering Center, near the United Nations Building on First Avenue, at a cost of some 10 million dollars, with occupancy expected in 1961. That portion of First Avenue is being renamed "United Nations Plaza," with development plans making it a choice location. IES has been invited to take space in this proposed building. One inducement is that occupancy of this United Engineering Center will be limited to non-profit technical societies, introducing consideration of prestige and of opportunities for closer liaison with other technical societies.

Accordingly a Task Committee on Headquarters Location was appointed a year ago. To review, their assignment was: "To study all factors affecting choice of future location of our Society Headquarters, and to submit a recommendation to Council." Task Committee members were Past-President Duncan Jones of Toronto, Past-Regional Vice-President Cecil Pasley of New Orleans, Past-President Lee Tayler of Detroit, Past-Director John Walsh of San Francisco, Director Jerry Whitnell of Phoenix, with Past-President Marshall Waterman of Bloomfield serving as Chairman. During the fiscal year this Task Committee has made several progress reports to the Executive Committee and Council. At Council meeting in June, they made two recommendations. Briefly, the first recommendation is to stay in New York City, unless continuing study finds more evidence than now at hand to justify a move. The second recommendation is to continue the study, not only in relation to current factors but also in relation to possible future changes in Headquarters organization and in number, scheduling, and location of Council meetings. Council approved this report.

What about moving into the forthcoming United Engineering Center? Here again the Task Committee, assisted by the General Secretary, made a major study. Not all figures now available from the United Engineering Trustees are definite. Nevertheless, it is apparent that such a move would

involve a considerable increase in rental and related expenses, and that we would have an additional obligation to raise substantial funds for the new building. The Council action, without dissenting vote, was to advise the United Engineering Trustees that IES is not in a position to consider occupancy in the United Engineering Center on the basis of information received to date. Since this question of Headquarters location remains open, comments from members are particularly invited.

Headquarters Organization

Another Advance Planning Committee recommendation was creation of a new position in our Headquarters organization perhaps with a title such as Managing Director.

The primary purpose of the recommendation was to lessen the time and travel demands now placed on Council members and on the Society Officers, particularly the President, General Secretary, and First Vice-President. These time and travel demands, as our Society has grown in size and in variety of activities, have become serious burdens on the individuals and on their companies. If these burdens continue — or become still greater as our Society continues to grow — we face an unhappy prospect. This prospect is that increasing numbers of our members qualified to serve as National Officers or on Council will be unavailable for such election. Other purposes of the recommendation were to achieve more effective and more efficient Headquarters operation and, hopefully, to relieve some of the overload now carried by our Senior Staff.

After substantial discussion, Council authorized the Executive Committee to select a management consultant, within a specified modest retainer, to make a fresh and objective analysis of our Headquarters organization. Of ten applicants, we chose Cresap, McCormick and Paget, of New York. They did a fine, professional job.

Our present Headquarters organization, in terms of accepted business practices, is a bit complicated. Like the bumble bee, it really should *not* be able to fly. But it does! The effective and successful operation of Headquarters, with*out* an on-the-job Manager, is a tribute to the abilities and cooperation of the Headquarters organization. We pay particular acknowledgement to our truly dedicated Senior Staff — Dex Hinckley, Cash Crouch, Ruby Redford, and Clayt Ellis. The management consultant's recommendation would modify this to provide overall administration of Headquarters activities by a designated staff member. Without laboring the point, I believe it is apparent that under some setup such as this, the Officers and Council would be much less involved in details of the management function. They would then be able to devote *more* time to their proper functions — planning and policy.

What has been done about this recommendation? A Task Committee on Headquarters Organization has been appointed to study the report and make a recommendation to Council. The appointments were made by President-Elect Taylor, because any action will come in his administration, or later. The Task Committee members are W. P. Lowell, Jr., C. W. McCormick, K. M. Reid, C. C. Shotwell, R. G. Slauer, and R. F. Hartenstein, Chairman.

Illuminating Engineering Research Institute

Some years ago the leaders of our Society began dreaming and talking of an IES program of basic researches on quality and quantity of illumination. They took steps to make their dreams become realities. They were truly pioneering steps; so far as I can learn, only one other engineering society had undertaken anything quite like this. You know the result — organization of our Illuminating Engineering Research Institute. It is largely financed by the IES, but separately administered because of its special problem in planning a research program and in placing and supervising research contracts with major Universities.

The first research contract was made in January 1947. Under this contract the University of Michigan studied "Controlling and Redirecting Daylight with Louvers." Since that date we have made 33 contracts covering a wide range of studies relating to quality and quantity of illumination. Universities with which contracts have been placed include University of Michigan, Pennsylvania State, Cornell, Ohio State, University of California, Tufts, MIT, University of Illinois, Southern Methodist University and others.

The total of the contract payments on these researches to date is almost exactly $200,000. This is no small sum. Further, research contracts placed with universities are truly bargains. Much of the *time* put on our projects, by faculty members and by graduate students working for advanced degrees, has been free. Use of *existing* laboratory and research facilities has been free. We in the IES have paid nothing for an immense amount of directly related research work financed by the United States Government, by the universities themselves, and by companies and other organizations, for example, turnpike authorities interested in better visibility for motorists under conditions of fog. Most of our funds have been used simply for special

research facilities required by our projects, for part of the cost of faculty supervision, and for part of the cost of observers — all at the moderate rates of pay prevailing in universities. In short, for every dollar we have invested in these projects, we have received several dollars worth of work.

Our research contract payments of $200,000 are not the whole story. In addition, we in the IES have provided, at no charge to the Illuminating Engineering Research Institute, such services as they needed from the Society's technical staff. For example, C. L. Crouch has served as Secretary of the IERI Board of Trustees, and as Secretary of the Institute's Technical Advisory Committee. As nearly as we can determine, the cost to the Society of this time and travel and office expense has ranged from $5,000 to $10,000 a year. In most years the latter figure would apply, for a 12-year total of the order of $100,000. Adding this amount to the contract payments of $200,000, we have a total investment of about $300,000. This, I repeat, is no small sum.

It is further noteworthy that our contract projects have stimulated related studies, in the United States and Canada and also abroad. We have, of course, had the benefit of the knowledge gained through these studies, at no cost to us.

Well, what do we have to show for this activity? Principally four things:

First, from the 22 completed research projects and preliminarily from the 11 projects now going on, we have a great fund of new knowledge. In a little while I want to say something about just one part of this new knowledge. Let me simply say here that these research findings are providing a sound basis whereby we can render greater, more informed service to lighting users. Through such greater service we merit continued growth of our broad lighting industry, and our Society.

Second, among the staffs of the universities mentioned above, we have an invaluable item of good will. We have shown that a technical society *can* team with universities, objectively and harmoniously, in carrying out research projects benefiting *people*. In the past, university researches have been largely on *things* — properties and characteristics of materials. More recently, many of their research projects have been directed to matters of mass self-defense and military offense, for reasons we understand and approve. Our IES projects are so different. We are seeking to *benefit* people. No wonder the universities give us a cordial welcome.

Third, in the university staffs and among their holders of advanced degrees, we have a large and increasing number who have interest, and competence, in lighting problems. No longer are there just a *few* to whom we can go with a proposed lighting research and find interest and competence. This extension of interest and competence, like the university good will, is invaluable.

Fourth, and perhaps most important, we ourselves have a great source of satisfaction. We are doing something for the betterment of mankind. We are doing something to make the world a better place in which to live. Through these researches we are doing something, collectively, that we could not do individually — that even our great companies probably could not do. All of us may feel proper pride that part of our modest dues as IES members help to pay for these researches. Our Sustaining Members may take special pride that their dues provide the bulk of the financing of these researches. Let us be thankful that this Society, our Society, has had and still has the vision and the courage and the ability to organize and carry out such a valuable service.

So much for the past, and the present. What about the future of our research program? You might like to know that the Illuminating Engineering Research Institute has six contracts ready to sign. These contracts hold exciting prospects of still further advances in standards of lighting practice. In every instance, the work is ready to start. In fact, if some of them do not start very soon, the researchers involved will be committed to other projects — outside of lighting.

These pending contracts, ready for the fiscal year 1958-59, will represent a total investment of $75,000. In draft form, with details to be influenced in part by the findings of 1958-1959, is a 1959-1960 research program. This, too, will represent an estimated investment of $75,000. If the Research Institute is to render this service, they need $150,000 during the next two years.

Where can they get this money? Hopefully $20,000 a year will come from the IES. Perhaps we can provide something more than this, although the Society's present financial position strongly suggests caution against over-enthusiasm. Where else? The Institute Trustees have decided to tell the story of these proposed researches to Foundations, and to companies and organizations within and in some cases outside of the lighting industry. If these organizations wish to contribute to specific researches, or to the program as a whole, they will be invited to do so.

Just one word of clarification in regard to IES Sustaining Members. The Research Institute Trustees, in inviting any IES Sustaining Members to contribute directly to these researches, will make it clear that they are in no sense *competing* with the IES Sustaining Member dues. Rather they will

urge — in fact, will insist — that any such direct contribution to the research program be over and above the Sustaining Member dues. This is the way special contributions to our researches have been handled in the past — for example, the study of visibility in fog, and certain daylighting projects. As you know, the annual Sustaining Member dues go in part for research and in part for the manifold services rendered by our Society. In contrast, any special contributions to the Research Institute would be for only one or two years, as a donor might wish, and would go entirely for research. Your assistance in making this distinction clear will be appreciated.

Researches on Quantity of Illumination

The University of Michigan studies on quantity of illumination exemplify the direct, practical value of our research projects. Dr. Blackwell's paper at this Conference has told that story, in all its thrilling steps. Let me simply say that this whole activity has reached the degree of completion it now has only through a truly magnificent team effort. Dr. Blackwell and his associates made a commitment to finish their researches within a specified time. Such commitments are seldom if ever made, because the course of any research is largely unpredictable; they run into troubles.

Well, this one ran into troubles. New facilities had to be designed and built. New sets of measurements had to be made and analyzed. The researchers responded to this emergency, this challenge, by putting in an inhuman amount of overtime, for which they received no extra money. Volunteer workers — C. L. Crouch, S. K. Guth, A. A. Eastman, and others — joined them in their almost-around-the-clock labors. The researchers were finished — on time. Meanwhile the Society's technical committees supplied a wide variety of well chosen, representative visual tasks for evaluation in the researches. The Committee on Recommendations on Quality and Quantity of Illumination held three meetings, far into the nights, with Ben Benson as Chairman and chief work horse. A substantial number of our technical committee members attended the Research Symposium in Dearborn to learn first-hand of the research findings. Then all the technical committees involved in the new footcandle recommendations met at Dearborn, on the same date, thereby achieving coordinated actions. Since that time the technical committees, our Headquarters Technical Office, Council, and others have been studying the committee reports, refining them, reconciling inconsistencies, and generally bringing them to proper completion. It has indeed been a magnificent team effort. We owe a salute to all who took part.

As most of you know, many of the new recommended footcandle values, based on this new knowledge, are substantially higher than those formerly recommended by the Society. In some cases the new values are two to three times the old. These increases raise certain proper questions, within and outside of the Society. Four questions most frequently asked, and my answers, are:

Question No. 1. Is there a sound *scientific* basis for the new values?

Answer. Yes, the new values have a more comprehensive, more rational, more scientific basis than we have ever had before. I invite you, and all others interested, to check this answer for yourselves, by listening to and studying the Blackwell report. The report has been presented as a Technical Paper at the conference. A summary of this is in August I.E.

Question No. 2. Is it valid to recommend such substantially increased illumination on the basis of just *one* research?

Answer. The Blackwell studies are *not* just one research. They have been in progress for over 8 years. They have encompassed a dozen or more phases, *each* of which was a major research project. Quite possibly in *number* of observations, and in research *staff*, and in *expense*, these studies equal or approach the total of *all* former studies directed to this specific problem of the amount of light needed for everyday seeing tasks.

Question No. 3. Are the newly recommended values *attainable?*

Answer. So far as I can determine, every one of the new values is attainable by correct use of available sources, equipments, and lighting techniques. But just as a reminder, when illumination values go up, we must be increasingly careful to retain proper brightnesses and contrasts for comfort. And one other comment, in industrial lighting particularly the new values contemplate more widespread use of localized lighting as a supplement to general illumination, here again with proper attention to brightnesses and contrasts.

Question No. 4. Are the newly recommended values economic?

Answer. Psychologists tell us that about 87 per cent of all human actions take place as a result of the sense of sight, which in turn depends on light. Very likely this percentage is still higher when applied to tasks in offices and industry, to the learning process in schools, to purchasing motivation in

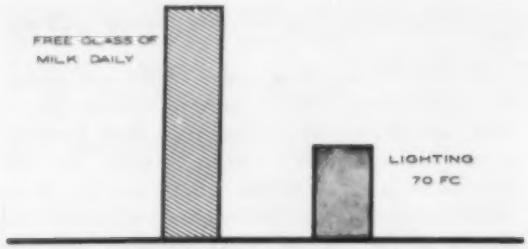


Figure 1. 70 footcandles compared to free glass of milk, for grade school pupil.

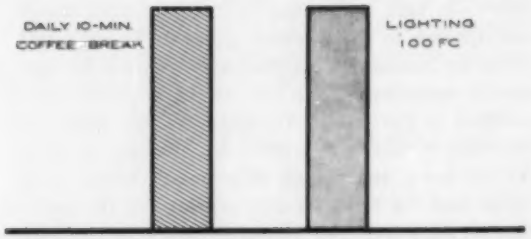


Figure 2. 100 footcandles compared with 10-minute coffee break, for general office worker.

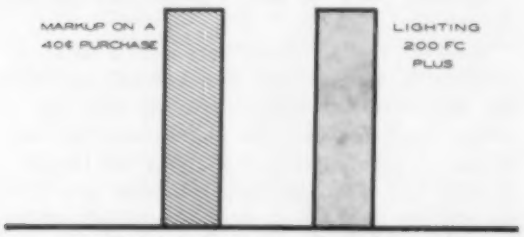


Figure 3. 200 footcandles plus compared to markup on a 40-cent purchase, for supermarket shopper.

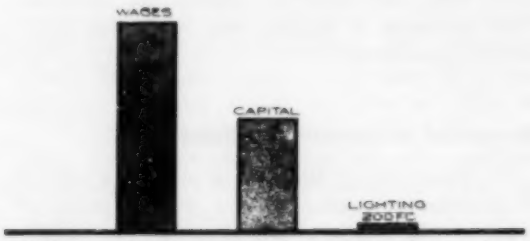


Figure 4. 200 footcandles compared to wages and capital, for an industrial worker.

stores, and so on. One might generalize, then, that good light is so important in our times and to our economy that once we know how much light we really need, we can afford it. Or conversely, we cannot afford not to have it.

But that generalization is not a very satisfactory answer. We as individuals and as organizations have established certain patterns of expenses. Any departure from that pattern comes into special scrutiny, in comparison with other items in the pattern. Very well, how does the *total "owning and operating cost"* of lighting, of these new and higher levels, compare with other items of cost in their respective environments.

In grade school class rooms, Fig. 1., good 70-footcandle lighting costs less than half as much as a daily free glass of milk for each child. The milk is undoubtedly valuable in child health in many cases, and is being advocated widely. The lighting affects the entire educational process for *all* the children. Which is more important?

In general offices, Fig. 2, good 100-footcandle lighting costs about the same as one daily 10-minute coffee break. I refer to the cost of the time not the coffee. Coffee breaks are widely considered justified by the psychological "lift." Good lighting gives a "lift" too, all day, plus more efficient operation.

In supermarkets, Fig. 3, really good lighting comprising 200 footcandles of general illumination plus wall and accent lighting, is paid for if each shopper buys just one more item — that is, spends $10.40 instead of the average $10.00. And if fine lighting brings in a few more shoppers, it's paid for and plenty over.

In a typical industrial area, Fig. 4, really good lighting, again 200 footcandles, represents about two per cent of the total wage and capital charges. The lighting is paid for if it saves the workers about 6 minutes in an 8-hour day. Just as one of hundreds of examples, a Los Angeles manufacturer reported productivity up 16 per cent and reworks and rejects down 26 per cent after putting in a well-designed 200-footcandle lighting installation. Obviously this lighting is paying for itself many times over.

Many other significant comparisons might be made. Why don't you try a few? Then, using your own figures, you can join me in the answer, "Yes, the newly recommended values of illumination are economic."

Communication

Our research program in the future — if it grows as we hope it will — may be expected to yield new knowledge in greater amounts and in lesser time. This new knowledge will surely point to further changes in lighting standards and lighting techniques. Naturally we will be eager to incorporate such changes promptly in our recommended practices.

Let me simply remind you that we have here a problem of communication, in which all of us have a part. After we have new knowledge, from our researches, the facts must be made known widely, for study, for discussion, for probing of any weak-

ness or gaps in the knowledge. With adequate communication, keyed to our accelerated research program, we need have no doubts about acceptance, within the industry and among lighting users, of sound changes in lighting standards and lighting techniques. But we must have communication.

Quotes

I would like to conclude this report — overly long, I fear — with two quotations. One is from St. Paul's first letter to the young church at Corinth. He wrote: "The eye cannot say to the hand: I have no need of thee. Nor the head to the feet: I have no need of thee. For the body is not one member, but many. When one member suffers, all suffer. When one member is honored, all rejoice together." These words were written about 56 A.D., nineteen hundred years ago. Yet the message they carry — the fact of our interdependence one upon another, and the essentiality of teamwork — applies today to us in IES. Our teamwork for the most part has ranged from good to superb. Let us make the effort required to keep it so.

The second quotation is from Alexander Smith, Scotch author and philosopher of a century ago. He wrote: "Our memories are our only real possession. Only in them can we be truly poor, or truly rich." For Mrs. Reid and me, this past year has been filled with experiences of great friendliness and hospitality and thoughtfulness, all over our two countries. We are fabulously rich in our memories of those occasions. We thank you!

(Report of the Vice-President is on the following page)

Reprints of "Recommended Levels of Illumination"

Because of the intense industry-wide interest which has been generated by the Blackwell studies on required quantities of illumination, a limited number of reprints of the feature, published in August I E, on "Recommended Levels of Illumination" are being made available. Price is 20¢ each in any quantity.

The 20-page reprint includes a description of the research procedure, a report of the IES Committee on Recommendations for Quantity and Quality of Illumination and the new footcandle recommendations for six areas — Office, Industrial, Institutions, Residences, Stores and Marine Transportation.

Since the *complete* footcandle tables will not be published until they appear in the Third Edition, *IES Lighting Handbook*, in March 1959, copies of this feature will serve for reference purposes in the meantime. Order from Publications Office, Illuminating Engineering Society, 1860 Broadway, New York 23, N. Y.

Vice-President's Report

By GEORGE J. TAYLOR
I.E.S. President, 1958-1959

In the United States, and possibly in Canada also, business in general has been experiencing a mild depression — what the newspapers term "an economic adjustment." In boom times or bad, however, in the field of illumination one thing is constant. That is the need for the application of good lighting principles. From data available, and from our own observations, we know that many interiors, as well as many streets and highways, are most inadequately lighted. Our opportunity for service in relighting these "under-privileged" areas presents a stirring challenge. The need is probably ten-fold what has so far been done.

Further, our new knowledge of the light required for specific tasks offers additional opportunity — if not obligation — for education and application. As a professional Society, and as individual members of the lighting field, we are faced with a gigantic undertaking in developing an educational program so wide as to reach every person interested in the recommendation, specification, application, installation, manufacturing and use of lighting for adequate and comfortable illumination.

Technical Accomplishment

Over the years, the technical work of our Society has provided valuable information to the lighting profession. Through its program of dissemination, this has been made available in Recommended Practices, Guides and Committee Reports. This year's technical achievements are especially impressive. Our technical committees have, quite obviously, worked hard and long. As a matter of interest, I present Table I showing post-war results in published technical reports of IES, totalling 51 in a period of some 12 years. For the year just closing, we already have nine reports approved by Council for publication, with 19 nearing completion. Some 20 other committees are now at work on still further reports. See Table II.

The dissemination of all the valuable information developed through committee reports, to our membership and to others, is a most important part of the Society's technical achievements. In fact, it is a basic objective of IES. Occasionally members are curious as to the Society's over-all activity in disseminating its information.

Aside from Illuminating Engineering, which goes to every member and several thousand non-members as well, probably the largest number of members are reached through local Section and Chapter meetings. Last year, over 30,000 people attended local IES meetings throughout the Society's then 82 Sections and Chapters. The programs they came to hear were for the most part practical and semi-technical papers which in one form or another presented the principles of good lighting that have been developed by IES committees or individual members.

Regional Conferences reach still another group of people. At these meetings, the programs lean more toward the semi-technical and technical aspects of lighting with many practical demonstrations of industry developments in lighting technique. At our National Technical Conferences, of course, the program is predominantly technical papers; the findings, you might say, of laboratory and industry studies.

TABLE I — Published Technical Committee Reports (1945-1957).

Nature of Report	Number
Recommended Practice	15
Residential	3
General	3
Commercial	4
Industrial	12
S.Q.Q.	5
Guides	9
Total	51

TABLE II — Committee Reports for 1957-58.

Nature of Report	Approved for Publication	Nearing Completion
Recommended Practice	3	1
Guides	1	3
Reports	2	8
Research Institute	3	7
Total	9	19

An Address presented at the National Technical Conference of the Illuminating Engineering Society, August 17, 1958, Toronto, Ont.

In recent years we have had another, most valuable means of disseminating practical information on the lighting art. I speak of the contest for "My Most Interesting Lighting Job." At every level, local, regional and national, this has been a popular Society project. Its value in disseminating information on the practical application of good lighting principles and stimulating ideas in lighting practice, cannot be overestimated. In addition, it has afforded hundreds of members each year the opportunity of presenting to their fellow members details of an installation which has been of interest to them. Probably a by-product benefit of this contest also, is the additional stimulation the contestant would be bound to experience, in marshalling the data and preparing the presentation of his interesting installation.

TABLE III — Page Content of ILLUMINATING ENGINEERING (October 1956 - September 1957).

Type of Publication	No. of Pages Published	
1. Technical		
Conference Papers, Abstracts, Discussion, Etc.	287	
Committee Reports	98	
Technical Papers	104	
	489 —	40%
2. Application		
Articles	102	
Data Sheets	43	
	145 —	12%
3. General		
Lighting News	137	
General Secretary's Report	16	
Committee Personnel, etc.	33	
Editorials	11	
	197 —	15%
4. Advertising	481 —	33%
Total	1312 —	100%

Our chief media for dissemination is, of course, our official journal ILLUMINATING ENGINEERING. Table III shows the page content for last year's operation. It is interesting to note that of the total editorial pages published (excluding the advertising pages) technical material, and application and general material was about 50-50.

In discussing the Society's technical achievements, I have mentioned only that of the technical committees. It is fitting, however, to draw to your attention the very extensive undertaking by our major application committees in the development of a new *IES Lighting Handbook*. There is no way to describe the gigantic job required for this project, except to say that it is downright hard work all the way. These committees are looking forward to the well-earned fruits of their labor — the new Third Edition of the Handbook, to be published early in 1959.

Technical Committee Forum

Organized some years ago, the Technical Committee Forum has every year been a most valuable means of correlating the Society's technical work. It is composed of the Chairmen of all IES technical committees. The First Vice-President of the Society is chairman of the Forum. This committee has been meeting once a year to discuss technical problems of major concern to the Society. Here too, an excellent opportunity is afforded for the exchange of ideas on different committee activities, and a good understanding of what each committee is doing. The Technical Committee Forums have without doubt resulted in a greater uniformity of opinions, which over the years interweaves and solidifies our over-all technical operations on a sound substantial basis.

It takes a great many people to serve our Society through its technical committees. See Table IV. In addition we have another excellent group of "Official Representatives to Other Organizations." Through these members our Society is represented on 18 American Standard Association Sectional Committees. We have, in addition, representatives on 15 well known organizations important to our

TABLE IV — Technical Committees

Committee	Chairman	Number Subcommittees	Number Committee Members
Aviation	L. C. Simpson	15	130
Color	R. C. Allison	—	2
Daylighting	H. B. Vincent	4	57
Design Practice	G. W. Clark	—	5
Education	Alston Rodgers	—	20
Handbook	J. J. Neidhart	—	6
Industrial	W. H. Kahler	6	15
Institution	L. V. James	5	33
Light Control and Equipment Design	J. T. McLaughlin	1	11
Light Sources	George Freeman	—	21
Maintenance	Francis Clark	—	13
Motor Vehicle	R. P. Teele	—	13
Nomenclature	Priscilla Presbrey	—	11
Office	G. F. Dean	—	16
Progress	E. A. Linsday	—	17
Public Conveyances	E. Boghosian	2	39
Quality and Quantity	B. S. Benson, Jr.	—	14
Residence	F. J. Marriett	3	23
Roadway	D. W. Rowten	11	60
School	J. M. Chorlton	5	32
Searchlight	J. P. Latil	7	25
Sports and Recreational	W. W. Weld	—	13
Store	Lester Geis	2	23
Testing Procedures	Phelps Meaker	15	77
Theater and Television Production	J. E. Rubin	—	20

25 Technical Committees and Chairmen, 78 Subcommittees and Chairmen, 696 Committee Members.

Society operation and to our mutual objective of getting lighting knowledge to the field.

Since our activities in the field of Committee reports has been so extensive this year, no attempt will be made to highlight the progress made. In due course all these reports will be published. However, we present Table V as an extraordinary report on technical committee action for 1957-1958. Only those committees who were actively working on specific assignments were invited to present their progress reports at the Technical Committee Forum held at Dearborn, Mich. in March 1958. These reports were so well presented and so fully packed with interesting, educational and useful information that they would in themselves make for an outstanding Technical Conference for our entire membership. Many committees not reporting at the Forum, however, are currently working on projects of major importance to our Society. These projects vary from entirely new concepts, to revisions of existing reports.

TABLE V — Select Reports by Chairmen of Technical Committees (1957-58).

Technical Committee Forum
Dearborn Inn, Dearborn, Mich.

1. Aviation	Recommended Practice for Aircraft Lamps
2. Education	Experiments with Light
3. Handbook	Revision Highlights
4. Industrial	Graphic Arts — Color Appraisal
5. Institutions	Church Lighting
	Lighting of Hotels
6. Light Control	Plastics Reports
7. Nomenclature	Several Segments reported
8. Public Conveyances	Recommended Practice for Marine Lighting
9. Residence	Contemporary Lighting
10. Roadway	Tunnels and Underpasses
11. Testing Procedures	Guide for Photometric Measurements of Fluorescent Lamps
	Guide for Electrical Measurements of Mercury Lamps
	Guide for Life Testing of Fluorescent Lamps
	Guide for Photometry of Searchlights
	Guide for Photometric Testing of Outdoor Fluorescent Luminaires
12. Searchlight	Nomenclature
13. School	Recommended Practice for School Lighting
14. Sports	18 minor sports areas
15. Theater–TV	Recommended Practice for Reporting Photometric Performance of Incandescent Lighting Units Used in Theater and TV Production.

Illuminating Engineering Research Institute

Last year President Reid explained the fine work being done by the Illuminating Engineering Research Institute. In his report he described some of the projects that were under study. A recent report by I.E.R.I. indicates the continuation of some of these projects with new ones added. The Research Institute has an outstanding staff of educated and trained researchers who are providing us with scientific facts on visibility and human behavior through sight.

While all the researches now underway are imminently valuable to our future lighting progress, the most exciting one of current interest is that of Dr. H. R. Blackwell on the development and use of a generalized method for specification of interior illumination levels on the basis of performance data. This work was presented in a most fascinating and dramatic manner at the Second Research Symposium held at Dearborn, Mich. on March 3, 1958. Over a hundred engineers and scientists listened to this brilliant young man expound for hours on a subject close to the hearts of all lighting engineers. Other prominent researchers presented startling new concepts and extension of some studies previously started.

Concurrent with the data made available by Blackwell and his associates, were studies made by the I.E.S. Committee on "Recommendations for Quality and Quantity of Illumination" (R.Q.Q.). This committee was charged with the assignment of reviewing Blackwell's data to present a comprehensive report at the Technical Committee Forum on new recommended footcandle levels for all types of seeing tasks. A resume of this one and one-half day Symposium program was vividly reported in the April issue of ILLUMINATING ENGINEERING. A summary of the Blackwell researches, the R.Q.Q. Committee's Report, and new footcandle levels based on these researches appeared in August IE.

Looking Ahead

It has been customary for the President-Elect to comment about services planned during his presidential year. These have been under constant review and guidance by the Advisory Board to the President during the past year. Many services which have been planned, and/or are underway, will continue into next year. These will receive preferred treatment for completion.

The Finance Committee is submitting for Council approval a proposed Budget for 1958-1959 showing less income than last year, with expenses essentially the same. As with private businesses, this calls for closer supervision of all funds. We are asking our headquarters staff to watch carefully all expenditures. In this connection also, we look to support from all committees and Sections and Chapters who receive funds for operating activities. Services to our membership will not be curtailed in any way. As a matter of fact, with closer attention to economy of operation, we look for extended services and benefits to all.

This year President Reid has not specifically listed "recommendations" as in the past. However, he has mentioned many items of general interest in the text of his address which require attention. And attention they will have! For instance, following this year's procedure, we expect to hold an Annual Corporate meeting at the National Conference in San Francisco. Continued study and consideration will be given to Headquarters location. New York City is widely favored, but further thought will be given to relocating in the new Engineering Building. It is likely that we will follow recommendations of the Task Committee in setting up at Headquarters, a managing director, together with some change in administrative procedures.

We look forward to the continuation of the good work of all our technical committees. The Third Edition of the Handbook is set for publication in the Spring of 1959. The new footcandle levels will require wide support of our entire membership. A gigantic educational program is required to bring our findings to the attention of the lighting profession and the public. The Public Relations and Information Committee is planning to meet this challenge. Many other equally important activities confront us for the year ahead, and we are prepared to see them achieved.

Conclusion

Keeping pace with fast moving technical developments is not an easy task during these busy times. As a nation we have met a challenge in scientific development and technological know-how. While many of these national problems remain unknown to the public we have been appraised of the numerous uses of the atom for purposes of devastation or peace. Some of our electric utilities are experimenting with the practical use of nuclear energy. Our government has been busy in analyzing the atom for use in nuclear weapons. Satellites have been circulating in upper space in further search of scientific knowledge that may lead to drastic changes in our lives and living in perhaps the not too distant future.

Lighting continues to be the most useful by-product of many technical and scientific studies. Without it we have no basis to even start research. As simple as it may sound, the fact remains that without light there is no sight. So it is that most of our researches are dependent upon light and sight. Since this is true we as a lighting profession are held with the responsibility of developing the knowledge and producing light sources and equipments to meet many seeing needs. The Research Institute and the Illuminating Engineering Society as a whole have been meeting these challenges for a number of years and will continue to do so.

Certainly our technical committees have made spectacular progress in developing reports of great value to every segment of a work world. I personally wish to thank our productive committees for their response to my requests for action in producing reports for a record-breaking year. I wish to thank them also in behalf of the officers and our entire membership for the time devoted to keeping our Society abreast of the times in the dissemination of lighting knowledge. Our devoted Technical Director, Cash Crouch, and his staff, deserve praise for their efforts which often extend far beyond normal working hours.

Finally, I want to personally thank each and everyone for the high honor of election to the Presidency of the Illuminating Engineering Society. President Reid has set some pretty stringent precedents during his administration that demand continuation. Following him will be no easy task! However, I shall do my level best to perform all the duties required of the President of our great Society. Beyond this, I wish to express my heartfelt appreciation for the confidence you have expressed in electing me.

Lists of IES Committees
To Be in October IE

A Discomfort Glare Evaluator

Sylvester K. Guth

J. F. McNelis

A NECESSARY step in solving problems of quality of lighting is the development of adequate instruments and techniques. The primary purpose of the Discomfort Glare Evaluator is to provide a technique comparable to that used in the laboratory which will make it possible to determine how well an empirical method of computing discomfort glare ratings agrees with experimental subjective evaluations.

The components of the Discomfort Glare Evaluator, shown in Fig. 1, include a head rest with movable and fixed shields, a comparison source and control units for the experimenter and observers. When the movable shield is in the "down" position, the luminaires of a lighting system are excluded from view. When the movable shield is rotated upward, those luminaires within approximately 50 degrees of the line of sight are seen. The shield is made of diffusing plastic so selected that when illuminated by nearby luminaires its brightness approximates that of the field. The circular test-source, which consists of a transilluminated diffusing glass, is seen in a diagonally positioned mirror directly in front of the observer and located on his horizontal line of sight. Thus, the observer sees a luminous spot viewed against the far wall of the room.

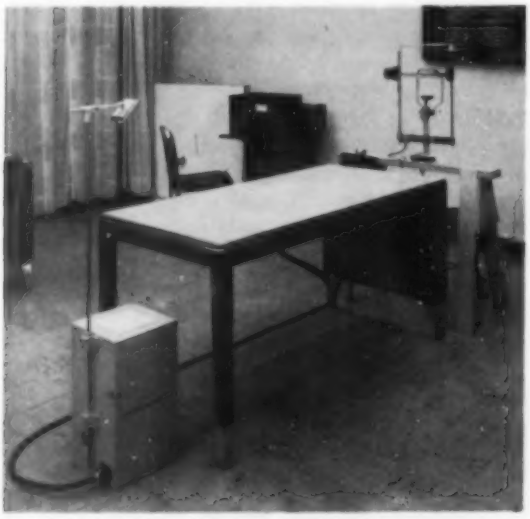


Figure 1. Discomfort Glare Evaluator showing the headrest with fixed and movable shield, test-source and control units.

The momentary exposure technique employed is similar to that used in the basic discomfort glare investigations.[1] A timing mechanism in the operator's control unit governs the exposure sequence of the circular test-source and luminaires. Two types of observations are made:

(1) *BCD Evaluations* — The movable shield remains down at all times and the observer adjusts the brightness of the test source until it produces a sensation at the borderline between comfort and discomfort. This is the BCD sensation.

(2) *Comparative Evaluations* — The test-source and luminaires are alternately exposed to view. The observer adjusts the brightness of the test source until it produces the same visual sensation as the luminaires.

AUTHORS: General Electric Co., Cleveland, Ohio.

Research

Subjective evaluations by 50 observers of five lighting systems provide a comparison with the basic BCD data and with computed discomfort ratings. The far wall brightness, against which the test-source was viewed, was taken as the field brightness and ranged from 1.3 to 34 footlamberts.

The relationship between BCD brightness, B, of the test-source and field (wall) brightness, F, may be represented by

$$B = 499\ F^{0.47} \qquad (1)$$

This compares with

$$B = 419\ F^{0.44} \qquad (2)$$

which was obtained in the original investigations.[1] The close agreement in the exponents of F is particularly significant. It indicates that the effect of increasing field brightness is very nearly the same for the present and original groups of observers. The coefficient of F, as determined in this investigation, is approximately 20 per cent higher. This indicates that, on the average, the present group is slightly less sensitive to brightness than was the original group.

Figure 2. Close-up of head-rest showing movable shield in "down" position.

TABLE I—Comparison-Source Brightnesses and Computed Ratings for the Luminaires of the Five Experimental Conditions.

	Experimental Conditions				
	A	B	C	D	E
1. Comparison Brightness (fL)	614	710	1476	1956	2567
2. BCD Brightness (fL)	555	1237	1264	2118	2581
3. Comparison/BCD	1.11	0.57	1.17	0.92	0.99
4. Luminaire Rating ($\omega/\bar{\omega}$)	0.73	0.25	0.92	0.60	0.74

Comparative evaluations obtained of the five lighting systems are illustrated in Table I.

The ratio Comparison/BCD (line 3) is an indication of the relative discomfort produced by the luminaires. Computed ratings obtained from a method suggested by Fry[2] are shown in line 4. The experimentally determined ratios and the computed ratings rank the five lighting systems in the same order. They may be represented by a straight line on logarithmic coordinates. Theoretically, the experimental (line 3) and computed (line 4) ratings should be expected to be equal. The fact that they are relatable to each other is significant and encouraging. Further detailed investigations with additional lighting systems should aid in resolving the differences.

These data illustrate that the Discomfort Glare Evaluator can be used for evaluating lighting systems. Furthermore, experimentally determined evaluations are relatable to computed ratings using the method proposed by Fry. Additional evaluations by large numbers of observers should make it possible to develop a subjective comfort-discomfort scale.

References

1. Luckiesh, M., and Guth, S. K.: "Brightnesses in Visual Field at Borderline Between Comfort and Discomfort (BCD)," ILLUMINATING ENGINEERING, Vol. XLIV, No. 11, p. 650 (November 1949).
2. Fry, G. A.: "The Evaluation of Discomfort Glare," ILLUMINATING ENGINEERING, Vol. LI, No. 11, p. 722 (November 1956).

(Abstract of I.E.S. Conference Paper No. 11)

Computation of Relative Comfort and Relative Visibility Factor Ratings for Roadway Lighting

Charles H. Rex

Most of the seventy million drivers in the United States make nighttime use of their multi-billion dollar investment in streets, highways, automobiles, trucks and buses. Roadway lighting for night driving presents a tremendous public welfare opportunity which is receiving increased attention from officials, engineers, technicians and those engaged in traffic and visual research. Progress in more efficient, pleasant and attractive night driving conditions is being aided by "figures of merit" for roadway lighting effectiveness. New traffic benefit ratings will evolve from current studies of operational night traffic capacity factors such as headways, vehicle formations, speeds, lane use and use of passing opportunities. These and other traffic benefits such as accident prevention, convenience and comfort are contingent upon the effectiveness of the lighting in producing good seeing.

Seeing benefit ratings may now be computed in terms of relative comfort and relative visibility. Computed ratings may be similar to those shown in Fig. 1 which are for a representative roadway lighting system with hypothetical candlepower distribution from luminaires spaced 120-foot staggered. This paper presents a method and data for computing such ratings, as well as such factors as pavement brightness, obstacle brightness and the loss of visibility due to disability veiling brightness. Fig. 2 shows an example of available data used for computation of pavement brightness.

The importance of a good relative comfort rating compared with or accompanied by a high relative visibility rating will evolve from correlated effectiveness ratings in terms of traffic benefit. Both seeing factor ratings and traffic ratings will also in-

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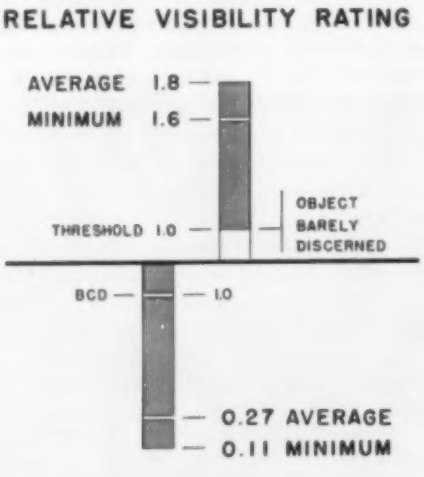

Figure 1. Example seeing factor ratings for a representative roadway lighting system. Relative visibility ratings may now be accompanied by computer ratings for relative comfort. Visual comfort rating is relative to the sensation which would be at BCD for the lighted roadway and system of luminaires.

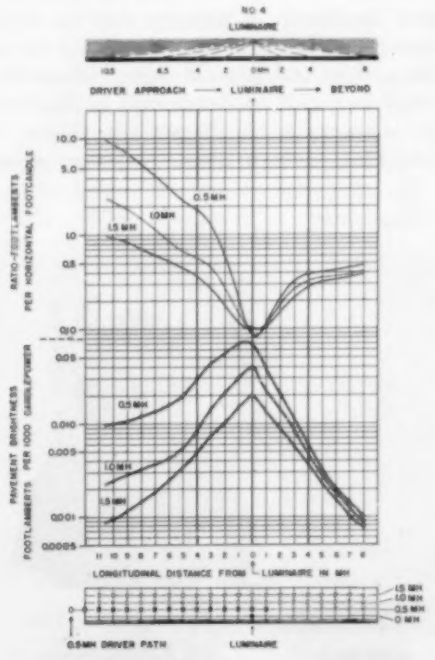

Figure 2. Pavement brightness produced per 1000 candlepower from a single luminaire at drivers' right is shown in lower portion of diagram. Longitudinal distance of driver observation from each pavement brightness station is 7 MH or about 210 feet. Curves on upper portion of diagram show the ratio of pavement brightness per horizontal footcandle produced by luminaire at pavement stations.

dicate how much better good roadway lighting is as compared with poor lighting or no lighting.

Computation of simplified ratings such as those shown in Fig. 1 has many advantages such as:

(1) The effectiveness of roadway lighting will be predicted in readily understandable terms of roadway user benefit.

(2) Application and luminaire performance variables will be explored, evaluated and controlled in design for optimum over-all efficiency.

(3) Comprehension of objectives will be improved, complexity reduced and standardization possibilities revealed.

(4) Progress in dynamic visual research under night driving conditions will be encouraged by a method for the use of laboratory and field data now available and to be made available in the future.

(5) Time will be conserved. Computation facilitates ratings without the delays, uncertainties and interferences that may arise in field testing. The use of high-speed computer techniques is obviously feasible and desirable. With example ratings available, other ratings may be estimated by interpolative judgment.

Better appreciation of roadway lighting effectiveness will result from numerical ratings in user terms such as relative comfort and relative visibility. "Figures of merit" also direct attention to the technological details by which seeing will be further improved. Improved night motor vehicle transportation is an objective which warrants the combined use of the best research data and engineering skills.

(Abstract of I.E.S. Conference Paper No. 13)

A Study of Glare from Very Large Sources

By R. G. Hopkinson (left) and R. C. Bradley*

THE PRESENT study was initiated to extend our knowledge of glare from very large sources such as over-all illuminated ceilings or large windows, even to conditions where the whole field of view itself may be a source of glare discomfort. The study was discussed initially by E. M. Strong, C. L. Crouch and the senior author, and has been conducted jointly as Project No. 59 of the Illuminating Engineering Research Institute on the one hand, and on the other, as an item of the research program of the Building Research Board of the Department of Scientific and Industrial Research in the United Kingdom.

Earlier studies on discomfort glare were limited by the design of the apparatus to a consideration of relatively small sources. Such studies covered most of the conditions ordinarily encountered in lighted streets or in the interiors of buildings with conventional lighting fittings. Independent studies in laboratories in different countries have shown a good measure of agreement, such that a basic expression can be derived for the relation of the physical variables which govern glare discomfort. This relation can be expressed by the formula

$$\text{Glare constant } G = \frac{B_s^{x} Q^{y}}{F^{z}} \cdot f(B_i) \cdot f(\theta)$$

where B_s = luminance of the source,
Q = apparent size of the source,
F = surround luminance,
B_i = luminance of immediate surround to the source,
θ = angular separation of source from line of sight.

It now seems likely that agreed values for the indices x, y, and z can be derived from the more comprehensive of the researches on glare discomfort. These values will probably be of the order of

$$x = 1.6$$
$$y = 0.8$$
$$z = 1.0$$

It is very satisfactory that agreement on such a psychological factor as glare discomfort can be reached. In arriving at agreement on a formula, it was, however, recognized that an expression of

*Photograph not available.

AUTHORS: Building Research Station, Garston, Herts, England and Cornell University, Ithaca, N. Y.

the form given above could be valid only over that range of conditions where the adaptation level is governed primarily by the surround luminance F, and where it is virtually independent of the source luminance B_s. Such conditions apply only when the source is not very large and does not produce a very high retinal illumination.

If the source is large, the adaptation level is influenced by the source and is determined only partly by the surround luminance. In such circumstances the simple formula given above is no longer valid. It has been practicable to solve many practical problems, such as that of glare from large windows or luminous ceilings, by extrapolation of the existing experimental data, but such a procedure requires a deeper knowledge of the experimental conditions than the practicing lighting engineer can be expected to have. A detailed study of the effect of very large sources on glare was considered essential for progress.

The experimental arrangement is based on a very large uniform source consisting of a bank of closely-packed fluorescent lamps whose light is diffused by an opal screen, so presenting a large surface of uniform brightness to the observer. A system of dimmers permits a smooth control, either by the subject himself or the experimenter, of the luminance of this source from about 1.0 footlambert to 4500 footlamberts (0.002-10 candelas/square inch). A series of masks placed over the large source, together with adjustment of the observer's distance from the source, gives a range of source sizes from 3×10^{-3} steradian up to full field (5 steradians), the latter being achieved in the British apparatus by a system of mirrors set around the observer when he is positioned close to the screen.

The surround luminance is provided by other fluorescent lamps, also on dimmers, set in a system of screens such that a substantially uniform surround luminance is seen by the observer with as little interference with the source luminance as possible. Both source and surround luminance are monitored separately by photoelectric photometers suitably screened to limit their field of view.

Apparatus of this type has been set up in the Department of Electrical Engineering at Cornell University, Ithaca, N. Y., and at the Building Research Station, Garston, Herts, England. The experimental work is being conducted in parallel, with the difference that the English investigation is essentially a pilot study directed more towards an exploration of the problem with a few observers, whereas the Cornell study is designed to supply the basic data from a large number of observers.

The conduct of the experiment is as follows. The source is continually exposed to the observer, who looks directly at it. He is allowed to become fully adapted to the conditions and is asked to adjust the luminance of the source to give, in succession, a predetermined series of criteria of glare discomfort. Sufficient time is allowed for adequate adaptation to each condition of the series of criteria. Such a series of judgments is made at each of eight source sizes. During the course of each experiment the surround brightness is maintained constant at a predetermined level.

An interim report has been presented at the National Technical Conference on the data so far obtained at Cornell and at Garston. A full report will eventually be prepared on the completion of each stage of the study. The results given in the paper are not final because at the time of writing the research project at Cornell has still three months to go and that at Garston is planned to continue for some time ahead. The purpose of the paper is to indicate to what extent ideas on glare discomfort, and in particular on brightness limits for comfort, must be revised when very large sources are under consideration.

Not the least valuable result of the study has been the opportunity afforded for closer collaboration at the experimental level between American and British workers.

(Abstract of I.E.S. Conference Paper No. 12)

Measurements and Calculations

Bill F. Jones

J. Roy Jones

A Versatile Method of Calculating Illumination and Brightness

THE CURRENTLY used system of classifying room shapes for the purpose of calculating illumination has a number of disadvantages. Among these is the fact that different formulae are used, depending upon whether a unit is primarily direct or indirect. These formulae are equated at the arbitrary mounting height of one-third the distance from the ceiling to the work plane, leading to inaccuracy which may vary from negligible to vital in normal sized rooms.

The confusion and inaccuracy which result from the dual formulae can be eliminated by a new approach. One such approach, as shown in Fig. 1, divides the room into three basic cavities:

(a) The cavity above the luminaires;

(b) The cavity below the workplane;

(c) The space bounded by the planes of the luminaires on the top, the work plane on the bottom and the walls of the room.

AUTHORS: Smoot-Holman Co., Inglewood, Calif. and Westinghouse Electric Corp., Los Angeles, Calif.

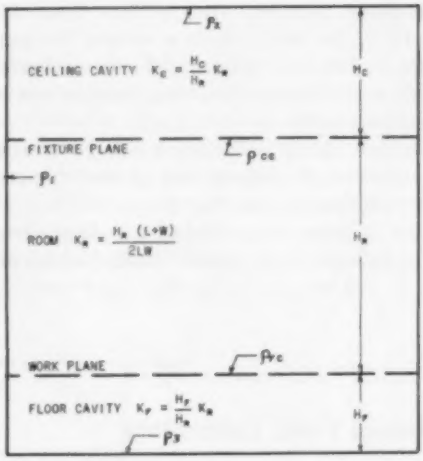

Figure 1. Method of splitting room into three sections. ρ_{ec} = effective reflectance of ceiling cavity; ρ_{fc} = effective reflectance of floor cavity.

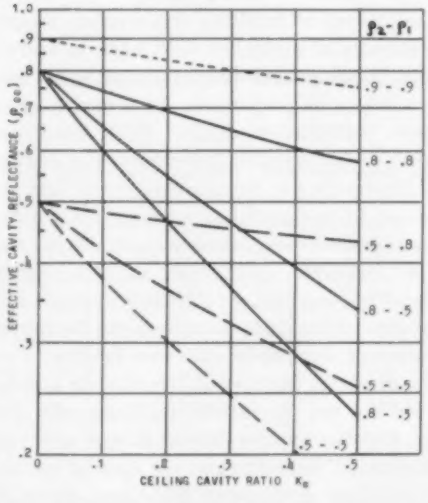

Figure 2. Effective ceiling cavity reflectance as a function of cavity ratio for several combinations of reflectance.

Once this is done, the ratio of the basic room can be computed by the formulae in Fig. 1, and the two cavity ratios found from the simple relationships given in the drawing. If these two cavities are then treated as the ceiling and floor of the room, with an effective reflectance that of the cavities, considerations of mounting height and work plane height vanish from the problem, allowing accurate calculation for any desired mounting and work plane height.

In addition, this procedure allows easy interpolation; simplifies the calculation of coefficients of utilization; permits treatment of rooms in which wall reflectance above the luminaires and below the work plane (dadoes, etc.) differs from the remainder of the wall; yields a method for handling partitions within a room and focuses attention on the effect of varying mounting heights and upper wall reflectances.

Effective cavity reflectances can be determined by a number of methods and plotted for any desired combination (see Fig. 2).

With the room now reduced to a single element, the limitations of the current method of calculating coefficients, imposed by the exponential approximations of the interreflection equations and by the assumption of uniform initial flux over the wall surface, can be removed by utilizing the luminous analogue computer developed by Professor Philip F. O'Brien of U.C.L.A. Rewriting the basic flux equations in a form which allows a surface to exchange flux with itself, it becomes possible to divide the walls into bands encircling the entire room at various levels. If enough bands are used, and the initial flux to each band determined, the final brightness distribution on the wall and the flux to the work plane (which is now the "floor") are quite accurately determined. The net result is a more accurate determination of the coefficient of utilization. A comparison of the above method with an exact analytical solution by Dr. Spencer showed agreement for utilization factor within approximately one-half of one per cent.

A system has therefore, been presented which is able to comprehend, at the engineering level, conditions outside the limitations of the present system and also results in more accurate calculations.

(Abstract of I.E.S. Conference Paper No. 21)

Visionics Field Laboratory

Benjamin Goldberg

Robert S. Wiseman

One of the important missions of the United States Army Engineer Research and Development Laboratories, Ft. Belvoir, Virginia, is to develop warfare vision equipment for the Army. In the process of fulfilling this mission, a considerable amount of nighttime field work in searchlight testing, viewing devices evaluation, and vision research has to be performed. In order to get quantitative information under field conditions, a visionic system outdoor laboratory was established. This laboratory has been automated so that various tasks can be accomplished with the least difficulty, and atmospheric conditions present during the test can be measured. Functions such as searchlight photometry, analysis of viewing systems and atmospheric optics data collection can be performed quickly and accurately with this facility.

The essential features of the visionic system laboratory are the Operations Building with Control Room and Goniometer Room, Range and variable Background. Searchlights are located on the 10-foot diameter goniometer table and photocell receivers can be located at any one of ten junction boxes equally spaced along the 3144-foot range. The information is transmitted to instruments for correlation with goniometer orientation. Visionic viewers can observe military targets against a 20- by 50-foot background which has controlled variable reflectance. A standard 8- by 8-foot target is also located in front of the background and can be remotely controlled to appear and disappear. This facility also is equipped for collecting data relating to atmospheric optics.

(Abstract of I.E.S. Conference Paper No. 8)

Authors: Warfare Vision Branch, U. S. Army Engineer Research and Development Laboratories, Ft. Belvoir, Va.

Predetermination of Luminances By Finite Difference Equations

Philip F. O'Brien

James A. Howard

Luminous flux transfer in an enclosure may be described by a system of linear simultaneous equations which are a finite difference representation of the Fredholm integral equation. The development of this method for the analysis and synthesis of lighting systems is now being prosecuted actively on a world wide basis. These finite difference equations may be written in general form as:

$$\begin{vmatrix} 1/\rho_1 - F_{1\to 2} \dots - F_{1\to n} \\ -F_{2\to 1} + 1/\rho_2 \dots - F_{2\to n} \\ \vdots \quad \vdots \quad \vdots \\ -F_{n\to 1} - F_{n\to 2} \dots + 1/\rho_n \end{vmatrix} \cdot \begin{vmatrix} L_1 \\ L_2 \\ \vdots \\ L_n \end{vmatrix} = \begin{vmatrix} L_{01}/\rho_1 \\ L_{02}/\rho_n \\ \vdots \\ L_{0n}/\rho_n \end{vmatrix} \qquad (1)$$

In Equation (1), the reflectances of the various finite surfaces are designated by ρ_n and the geometry of the system is specified by the shape moduli, $F_{n\to m}$. If the lighting problem is concerned with *analysis*, Equation (1) is solved for the total luminous emittances $L_1, L_2, \dots L_n$. If the *synthesis* of luminous inputs to produce a particular emittance pattern is required, Equation (1) is solved for the stimuli $L_{01}/\rho_1, L_{02}/\rho_2, \dots L_{0n}/\rho_n$.

The admittance matrix containing reflectance ρ and geometry F terms may be inverted to produce an impedance or transfer-function matrix. This inverse matrix may be obtained by means of digital and analogue computers. The well-known interflectance table is simply related to the impedance matrix.

Truncation errors which are inherent feature of the finite difference equations can be reduced to acceptable levels by reducing the relative size of the finite areas that define a room. For example, the infinitely-long hallway shown in Fig. 1 was

Authors: Dept. of Engineering, University of California, Los Angeles, Calif.

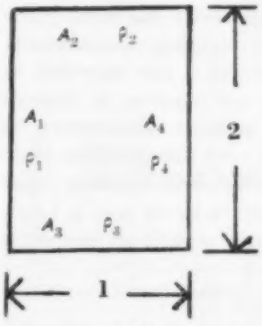

Figure 1. Infinitely long hallway with luminous ceiling.

TABLE I — Spencer's Exact and the Approximate (*i.e.*, based on finite difference equations) Distribution of Light in a Very Long Room with a Luminous Ceiling. $k_r = 1.0$ $\rho_1 = \rho_2 = 0.8$ $\rho_3 = 0.5$

Number of Wall Sections	Relative Luminous Emittance	Distance from Ceiling (Units)	Exact Emittance	Approximate Emittance	Truncation Error Per Cent
1	L_1 / L_{02}	1.00	0.5166	0.5329	+3.15
1	L_2 / L_{02}	—	1.4514	1.3952	−3.87
1	L_3 / L_{02}	—	0.3499	0.3682	+5.23
2	L_1 / L_{02}	0.50	0.6523	0.6447	−1.17
2	L_2 / L_{02}	1.50	0.4276	0.4335	+1.38
2	L_3 / L_{02}	—	1.4514	1.4306	−1.43
2	L_4 / L_{02}	—	0.3499	0.3532	+0.95
4	L_1 / L_{02}	0.25	0.7429	0.7276	−1.93
4	L_2 / L_{02}	0.75	0.5785	0.5740	−0.78
4	L_3 / L_{02}	1.25	0.4675	0.4650	−0.53
4	L_4 / L_{02}	1.75	0.3944	0.3926	−0.46
4	L_5 / L_{02}	—	1.4514	1.4442	−0.49
4	L_6 / L_{02}	—	0.3499	0.3491	+0.23
8*	L_n / L_{02}	—	1.4514	1.4488	−0.18

*Extrapolated value.

investigated for the truncation error by varying the number of wall sections. As shown in Table I, the truncation error is reduced from about four per cent to about one-half per cent when the number of wall sections is increased from one to four.

Additional numerical methods which need to be explored for applicability to the analysis of lighting systems are suggested in the paper.

(Abstract of I.E.S. Conference Paper No. 22)

Automated Universal Distribution Photometer

J. Stuart Franklin

PAUDGET, the subject of this Conference paper, is defined "Photometer, Automated Universal Distribution Gonio Electric Type." To meet present-day needs of photometric testing, this fully automated distribution photometer was born. Since the advent of fluorescent lighting, measurement requirements have necessitated a new approach to luminaire testing. Lamps are sensitive to changes in operating position, to ambient temperature, to thermal drafts; and their very size prohibits their being properly tested on previously available types of photometers. The design selected was a large, fully automated photometer, capable of operating all luminaires in their normal "in use" position, at any required test distance, at a standardized ambient temperature and with minimum thermal drafts.

Fig. 1 gives a pictorial view of the various major components, and a block diagram showing its elementary functional operation. Input and output information is in the form of tabulating cards, read and punched on an electro-mechanical card machine. Information read from cards is sent to the programmer, which is the "brain" of the system, co-ordinating all functions. The programmer positions the ferris-wheel-type structure in azimuth (fixture rotation) and in elevation (structure rotation on the large rings). The light output is read by the light read-out device into the card machine and the data is punched into the final tabulating card.

In PAUDGET, the luminaire rotates around an 8-by 12-foot mirror. It has four main advantages: (1) type "A" polar axis vertical goniometer; (2) permits mounting luminaires in their normal operating position; (3) tests at any distance because the reflected light beam always occupies the same line in space; and (4) uses a compact, well-balanced structure. Its basic size and complexity was deter-

AUTHOR: Photometric Laboratory, General Electric Co., Outdoor Lighting Dept., Hendersonville, N. C.

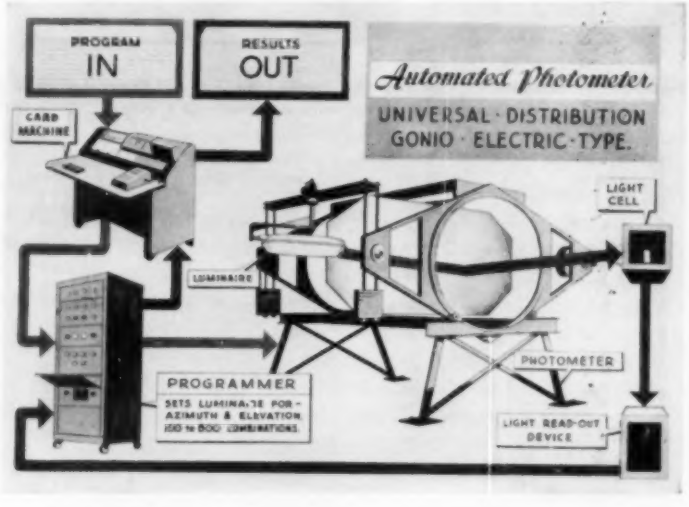

Figure 1. Functional Diagram. By following the arrows, the path of the input information on cards can be traced through the card reader tand program unit, to the photometer structure drive motors. Light output from the luminaire is measured by the light cell, sent to the light readout device, program unit, and to the card machine, where it is punched into the output card.

mined by our requirement for testing fluorescent luminaires up to eight feet in length and in operating positions up to 25-degree tilts above the horizontal.

The electrical control system presented many challenging problems that were overcome in the following design areas:

Servo Drive Circuits

Elimination of all mechanical, hand-operated structure drives necessitated three separate electrical drive systems. These employ a d-c amplidyne on the elevation drives and an a-c magnetic amplifier on the azimuth drive.

Visual Shaft Position Indicator

In order for the operator in the control area to always know the exact angular position of all shafts, synchros, a servo amplifier and a motor driving a three-dial, digital type bearing counter are employed.

Luminaire Power Circuits. A choice of three circuits is available to supply a-c, d-c, and miscellaneous power to the luminaire under test.

Control Circuits. Control circuits perform various functions necessary to the proper manual and automatic operation of the photometer and the safety of laboratory personnel.

Digital Readout Circuits. These circuits provide means for visually indicating and digitally recording the light output, the wattage, voltage or current of the luminaire on test.

Master Automatic Controls. Prepunched tabulating cards provide the input data needed for programming the angular positions of the structure and the readout data. It is basically a point-by-point positioning system which can be programmed to call for any type and number of reading stations desired simply by changing the input master card deck. Output data are punched into another set of tabulating cards.

PAUDGET records test data in approximately one-third of the time formerly required, while calculations are automatically made on electronic data processing machines in about 25 per cent of the time formerly required.

The paper covers the interesting design, construction, and operational aspects of the photometer, its present uses, and its future possibilities. It shows that the versatility of automation makes the rapid securing of information in any desired light pattern possible with PAUDGET.

(Abstract of I.E.S. Conference Paper No. 9)

Vertical Distribution of Light From Gas-Filled Candlepower Standards

L. E. Barbrow

S. W. Wilson

IN RECENT years gas-filled, clear-bulb tungsten filament lamps have been used in increasing numbers as standards of luminous intensity. These lamps are operated base down and have coiled monoplane filaments. When used as standards, they are marked with fiducial lines etched on the bulb so that they can be accurately aligned about a vertical axis. Investigations have been reported on the variation of candlepower of such lamps about a vertical axis but apparently no results have been reported on the much larger variations of candle-

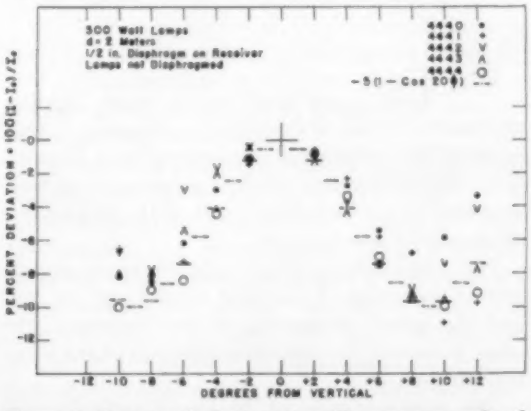

Figure 1. Per cent deviation of candlepower vs. angle of tilt of 500-watt C-13B filament lamps, Group No. 4. Also, a cosine curve with an amplitude of five per cent of maximum candlepower and a period of 18 degrees.

AUTHORS: National Bureau of Standards, Washington, D. C.

power of such lamps about a horizontal axis; that is, with angle of tilt.

Such results are reported in this Conference paper for several types and sizes of clear-bulb lamps commonly used as standards of candlepower at color temperatures above 2400K. In addition, preliminary results are reported on lamps with inside-frosted bulbs. It is shown that elaborate precautions must be taken in mounting clear-bulb lamps to make them as reliable candlepower standards as lamps with inside-frosted bulbs mounted by a very simple procedure.

(Abstract of I.E.S. Conference Paper No. 6)

G. A. Horton

R. C. Speck

P. A. Zaphyr

R. E. Wendt

Automatic Photometer for Street Lighting and Other Luminaires

THIS PAPER describes a street lighting photometer which is completely automated so that no hand transcription of photometric data is necessary. The photometer which is automated has been described in the literature.[1] It is of the well-known single-mirror selector type.

The programming of the photometer is accomplished by means of two tape readers, one to control the lateral orientation of the luminaire, the other to control the vertical orientation of the selector mirror.

The measurements of luminous intensity are made by means of a microampere null-type strip chart recorder which measures the current produced by a barrier-layer type photocell, the current output of the photocell being proportional to the illumination upon the cell. The angular motion of the recorder slidewire is at all times proportional to the illumination upon the photocell and an analog to digital encoder is mounted upon the slidewire shaft.

The readout from the encoder consists of a tape punch and an adding machine from which a trial balance of the luminaire efficiency may be made to check with the efficiency as measured in a photometric integrator. The tape from the punch is run

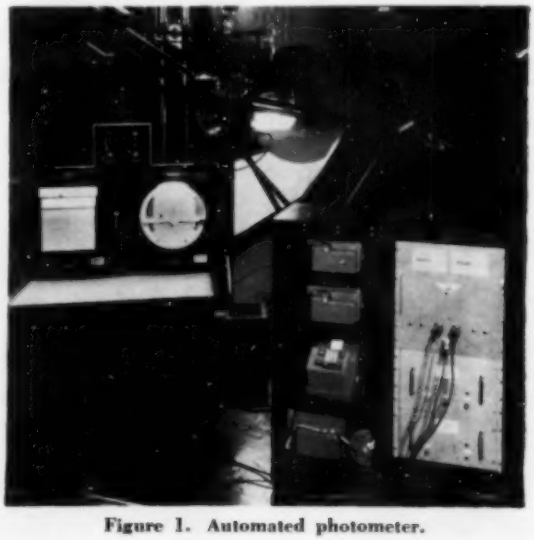

Figure 1. Automated photometer.

AUTHORS: Messrs. Horton and Speck, Westinghouse Electric Corp., Lighting Division, Cleveland, Ohio; Messrs. Zaphyr and Wendt, Westinghouse Electric Corp., Analytical Dept. and Manufacturing Engineering Laboratory, respectively, East Pittsburgh, Pa.

through a tape to card converter where the information is punched into IBM cards.

The reduction of the data in the cards to a useful photometric report is accomplished by a method described in the literature.[2]

The use of plastic tapes for programming the photometer makes it universal since the program may be changed simply by changing the array of holes punched in the tape.

The completely automated photometer is shown in Fig. 1.

References

1. Horton, G. A.: "Modern Photometry of Street Lighting Luminaires," ILLUMINATING ENGINEERING, Vol. XLIII, No. 11, p. 989 (November 1948).
2. Horton, G. A., and Zaphyr, P. A.: "Automatic Processing of Photometric Test Data for Street Lighting Luminaires," ILLUMINATING ENGINEERING, Vol. LIII, No. 6, p. 341 (June 1958).

(Abstract of I.E.S. Conference Paper No. 10)

Controlled Fluorescent Reflector Design For Sharp Cut-Off and Uniform Distribution

Domina Eberle Spencer

THE RECENT development of *very bright fluorescent lamps of small diameter* has made possible the design of fluorescent luminaires which produce a controlled distribution of light. Fluorescent lamps of this type have the following inherent advantages:

(1) By suitable reflector design all light from the fluorescent luminaires can be directed below a *chosen cut-off plane.*

(2) Design for *uniformity* is possible *with a single lamp* and is more effective than designs employing many lamps packed tightly together.

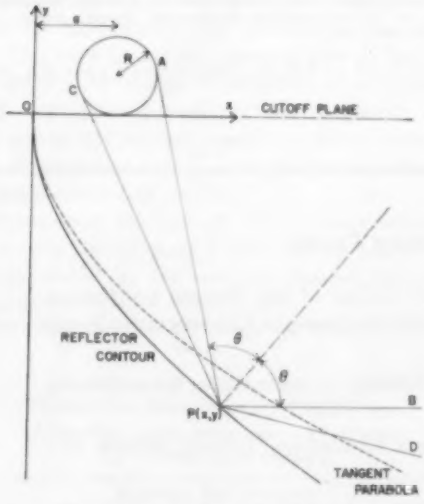

Figure 1. Contour for principal reflector. Solid curve shows non-parabolic contour required for horizontal cut-off plane (Equation 1) with lamp of finite radius. Tangent parabola (Equation 1a) is shown as dotted curve.

The design of controlled fluorescent luminaires requires the recognition of two basic characteristics of the fluorescent lamp:

(a) The *cross section* of the fluorescent lamp is finite and must be treated as such in the design.

(b) The distribution of light received from a fluorescent luminaire must be described in terms of the *converging* light cone.

The essential building blocks of the design procedures described in this paper are two families of reflector contours. The *principal* family of reflector contours is a generalization of the parabolic reflector, which is modified to take into account the finite cross-section of the fluorescent lamp. As shown in Fig. 1, the reflector contour is designed so that at any point P on the contour, the cone of light APC, subtended by the lamp, is reflected into a cone BPD, such that the uppermost ray PB is parallel to an arbitrarily chosen cut-off plane. Thus, if the reflector is perfectly specular, it sends no light above the cut-off plane. The equation of the contour can be written parametrically as

$$\begin{cases} x = a + \dfrac{1}{2}\left[y\left(-\dfrac{1}{p} \right) - 2pR \right], \\ y = 2p\,[a - R\tan^{-1} p], \end{cases} \qquad (1)$$

AUTHOR: Associate Professor, University of Connecticut, Storrs, Conn.

where $p = \frac{dx}{dy}$. If the radius R of the lamp approaches zero, Equation (1) becomes

$$x = \frac{y^2}{4_a}, \qquad (1a)$$

and the reflector is a parabola.

Secondary reflectors are sometimes needed. Here sharp cut-off is not ordinarily desired, so an elliptical contour can be employed, as shown in Fig. 2. Foci of the ellipse are at lamp center and pole base. A convenient form of the equation for the elliptical contours is

$$r = \frac{2a(a+b)}{(2a+b) + b\cos\theta}, \qquad (2)$$

where $a = \frac{\sqrt{(b-r_o)^2 + 2br_o(1+\cos\theta_o)} - (b-r_o)}{2}$.

To design a fluorescent reflector, a choice must be made among the various members of the two families of reflector contours. The paper describes how this is done for two special cases: a low-mounted system of fluorescent luminaires for illuminating runway or roadway surfaces and an overhead luminaire suitable for floodlighting or street lighting.

Essential to the design procedures are the study of interflections within the luminaire, consideration of the effect of louvering in clear weather and in fog, and the exact prediction of the distribution of incident light associated with lamp and each reflecting surface.

Experimental results are shown which illustrate the extent to which the twin criteria of sharp cut-off and uniform distribution have been satisfied in typical special cases. Thanks are due to Robert Cuikay and Lambert L. Montgomery of Sylvania Electric Products, Inc. for assistance in the calculations. An accompanying paper[1] describes the range of applications to which these design procedures have been applied.

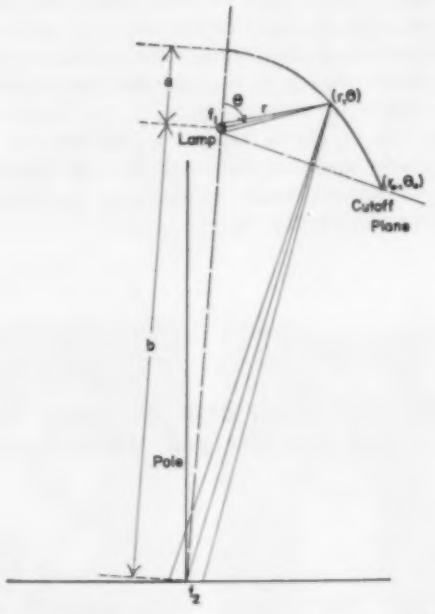

Figure 2. Design of an elliptical reflector to focus a controlled beam of light at base of pole.

1. Peek, S. C., and Keenan, J. P.: "Outdoor Applications of New Reflector Contour Designs for Higher Output Fluorescent Lamps," Conference Paper No. 35 presented at the National Technical Conference of the Illuminating Engineering Society, August 17-22, 1958, Toronto, Ont.

(Abstract of I.E.S. Conference Paper No. 20)

Discussion of IES Conference Papers

Discussion of papers presented at the technical sessions of the Toronto Conference should be submitted immediately for publication with the paper in ILLUMINATING ENGINEERING.

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Daylighting

Edward Linforth

Efficiency of Domed Acrylic Skylights

AN EVALUATION of the daylighting characteristics of dome-shaped acrylic skylights was made by the Daylighting Laboratory at Bristol, Pa. The tests included measurements of luminous and total solar energy transmittance, distribution, surface brightness and net efficiencies of dome-well-ceiling diffuser combinations. The results provide skylighting design and prediction data not available heretofore.

Transparent colorless or tinted domes are sometimes used for decorative purposes or where "picture windows" in the roof are desired but translucent domes which provide diffuse distribution of direct sunlight are normally specified for functional daylighting. Hence, domes and ceiling diffusers made of three representative densities of white translucent acrylic sheet were tested.

All domes were square in plan and formed from $^3/_{16}$-inch thick sheet to a height equal to 25 per cent of the length of one side. All ceiling diffusers were $\frac{1}{8}$-inch thick flat panels. The designations of the three densities and the luminous transmittance of the two thicknesses of each as determined by Hardy-type spectrophotometer for CIE Illuminant C are:

W-7328, thickness $\frac{1}{8}$ inch — 0.33, thickness $^3/_{16}$ inch — 0.23

AUTHOR: Rohm and Haas Co., Philadelphia, Pa.

TABLE I — Dome Surface Brightnesses. (Clear sky; solar elevation — 44 degrees; E_h = 8800 footcandles).

	Brightness (Footlamberts)			
Dome Type	Side Toward Sun	Top of Dome	Side Away from Sun	Variation Max./Min.
W-2447	9500	7300	5100	1.9
W-7328	4600	4200	3500	1.3

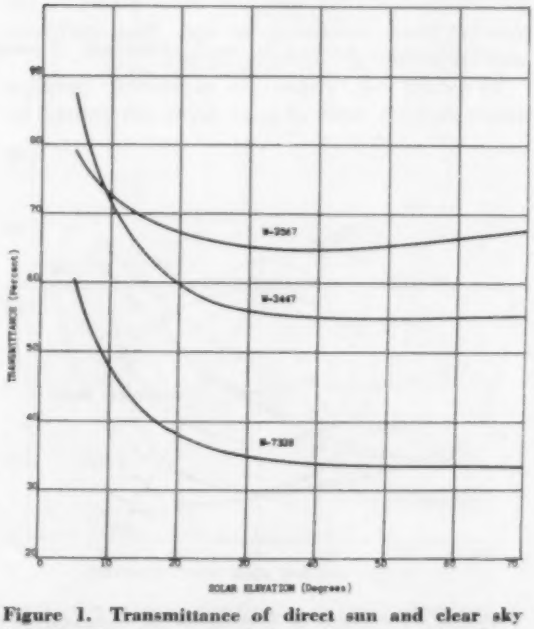

Figure 1. Transmittance of direct sun and clear sky light by W-series acrylic skylight domes vs. solar elevation. Top to bottom: W-2067, W-2447, W-7328.

TABLE II — Overcast Sky Transmittance Factors for Acrylic Skylight Fixtures.

Well Characteristics		Skylight Dome Type								
		W-7328 Diffuser Type			W-2447 Diffuser Type			W-2067 Diffuser Type		
Index	Reflectance	None	W-2447	W-7328	None	W-2447	W-7328	None	W-2447	W-7328
0.0	—	.35	.280	.198	.570	.408	.279	.691	.466	.320
0.1	.80	.320	.244	.175	.530	.370	.248	.611	.428	.294
	.50	.300	.224	.140	.494	.335	.225	.574	.396	.275
0.2	.80	.290	.219	.158	.485	.340	.223	.568	.395	.270
	.50	.264	.187	.112	.442	.284	.190	.545	.342	.236
0.3	.80	.266	.195	.145	.450	.313	.203	.533	.354	.248
	.50	.232	.158	.092	.380	.242	.165	.484	.302	.205
0.4	.80	.246	.180	.134	.415	.287	.188	.485	.331	.230
	.50	.205	.14[illegible]	—	.340	.212	.143	.429	.270	.182
0.5	.80	.233	.166	.123	.396	.268	.173	.458	.316	.218
	.50	.183	.122	—	.304	.188	.125	.378	.244	.162
1.0	.80	.163	.11[illegible]	.087	.270	.183	.123	.336	.222	.152
	.50	.104	.087	—	.174	.107	.071	.233	.146	.097
1.5	.80	.119	.086	—	.195	.129	.880	.248	.158	.110
	.50	.081	—	—	.102	.060	—	.137	.087	—

W-2447, thickness 1/8 inch — 0.56, thickness 3/16 inch — 0.44

W-2067, thickness 1/8 inch — 0.73, thickness 3/16 inch — 0.62

Measurements were made outdoors with an integrating sphere approximately six feet in diameter. Curves of transmittance in relation to solar elevation in clear sky for the three types are shown in Fig. 1. Comparable values obtained under overcast sky conditions will be found in Table II at Well Index, 0.0; Diffuser Type, None.

Distribution curves for two dome types are shown in Fig. 2.

Brightness observations were made with a Spectra Brightness Spot Meter at three angles in the vertical plane containing the sun. Test conditions and the results are given in Table I.

In actual use, domes are necessarily installed above skylight wells of some depth determined by the roof structure and curb height. In addition, diffusing panels mounted in the plane of the ceiling may be employed to improve lighting quality. Hence, the over-all efficiency of the skylight "fixture" comprising dome, well and, sometimes diffuser, is of primary practical significance. Net efficiency factors for various combinations of domes, wells and diffusers are given in Table II. They were obtained with the integrating sphere under solidly overcast sky conditions.

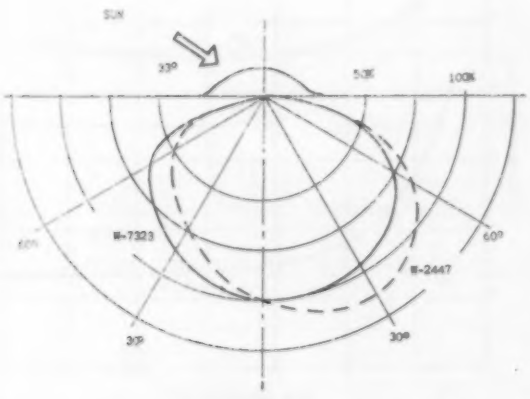

Figure 2. Distribution of W-series acrylic skylight domes in the vertical plane containing the sun shown as per cent of the vertical component (0 degrees).

Extensive tests of direct and diffuse total solar radiation transmittance of acrylic domes were conducted employing solar calorimeters designed in consultation with the Research Laboratories of the American Society of Heating and Air Conditioning Engineers. Details of procedures and results will be reported elsewhere. In summary, the combined direct and diffuse transmittances of domes made of W series acrylic sheet were found to be essentially the same as the luminous transmittance values, as might be assumed on the basis of the formulation of these materials.

The W series of acrylic skylights encompasses a wide range of daylighting characteristics. The over-all efficiency factors in Table II in conjunction with the brightness and distribution data provide a guide to the selection of type in relation to wells and ceiling diffusers to meet specific requirements imposed by use of the space, architectural considerations and availability of daylight at the site. It will be apparent that the choice, as in electric lighting, lies between large area sources of low brightness and small area sources of high brightness. The latter may be quite satisfactory for lighting areas where simply enough light is the objective. When the quality of the visual environment is of primary concern, large area sources of low brightness are recognized as essential.

(Abstract of I.E.S. Conference Paper No. 27)

Philip F. O'Brien

James A. Howard

Analogue and Digital Computer Solutions Of Daylighting Problems

ANALOGUE and digital computers may be employed for the solution of the finite difference equations which describe daylighting and/or lamp-lighting systems. Asymmetrical locations of daylighting sources and the non-uniformity of the outdoor luminance pattern are complicating characteristics which can be treated by this analytical method.

As an idealized example of this analytical technique, the luminous emittance distribution in the infinitely long hallway shown in Fig. 1 was computed with the Luminous Analogue Computer and the Bendix G-15D Digital Computer. The equivalent circuit solved by the Analogue Computer is shown in Fig. 2. The total luminous emittances computed by these two computers are compared in Table I and a difference of about one per cent is observed.

In Fig. 4, the illumination distribution obtained by analysis is compared to the experimental data

AUTHORS: Dept. of Engineering, University of California, Los Angeles, Calif.

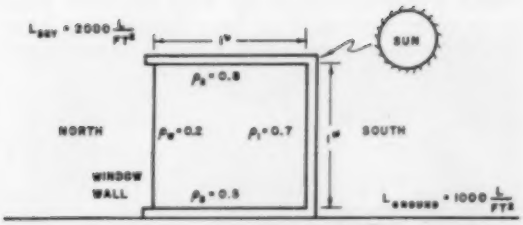

Figure 1. Sectional view of long hallway lighted from ground and sky through a window-wall of 80 per cent transmittance and 20 per cent reflectance.

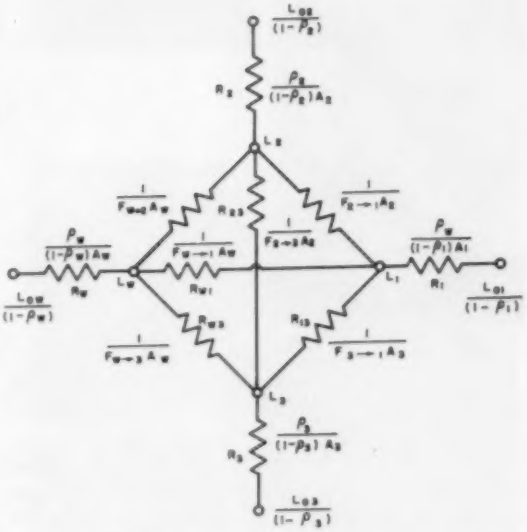

Figure 2. Equivalent circuit or network representation of the long hallway (Fig. 1).

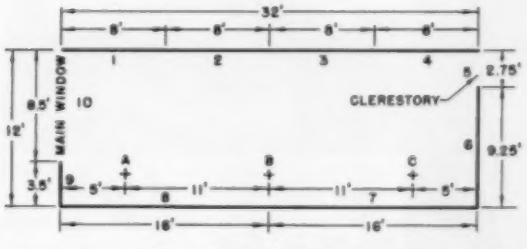

Figure 3. Sectional view of daylighted room studied experimentally by Southern Methodist University Daylight Study Project.

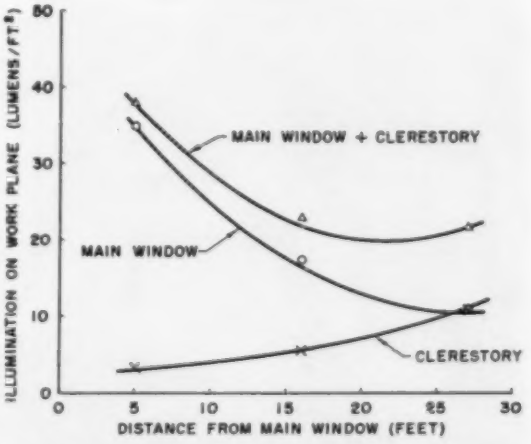

Figure 4. Illumination distribution on work plane and across the room with respect to the fenestration. The solid line was computed from the network, while the data points were obtained from the SMU Study.

TABLE I—Comparison of the Total Luminous Emittances of the Surfaces of the Long Hallway (Fig. 1) as Obtained with the Bendix G-15D Digital Computer and the Luminous Analogue Computer.

Machine	L_1	L_2	L_3	L_W
Digital Computer	565.74	487.03	432.79	100.75
Analog Computer	560	479	431	101
Per Cent Error	+1.02	+1.67	+0.42	−0.25

obtained by the Southern Methodist University Daylighting Study for the room shown in Fig. 3. The close agreement between the experimental and analytical data presented in Fig. 4 suggests that analytical techniques may be employed to study daylighting systems which are not now described by adequate experimental data.

(Abstract of I.E.S. Conference Paper No. 29)

Brightness Survey of Two Rooms Using a Photographic Technique

M. N. Zeolla

A METHOD OF brightness recording that would permit an almost instantaneous survey of large areas would be most valuable in daylighting surveys. The method should also permit making measurements under actual use conditions to obtain values that are realistic and useful. A photographic technique developed by Professor and Mrs. Charles Marsh of Pennsylvania State University most closely meets these requirements.

This paper describes a field trial of this technique. For this purpose, a brightness survey was made of large areas of two rooms at the Pittsburgh Plate Glass Co., Glass Division Research Laboratory. The survey was made without interrupting the work routine or disturbing the occupants of the rooms. The specially modified three-plate color camera and a Spectra Brightness Spot Meter were the only pieces of equipment used during the surveys. Photographic exposures of 30 seconds were used in photographing the scenes.

Areas of known brightness were included in all of the scenes to permit calibration of the brightness contours in the photographs. These areas were

AUTHOR: Pittsburgh Plate Glass Co., Glass Division Research Laboratory, Creighton, Pa.

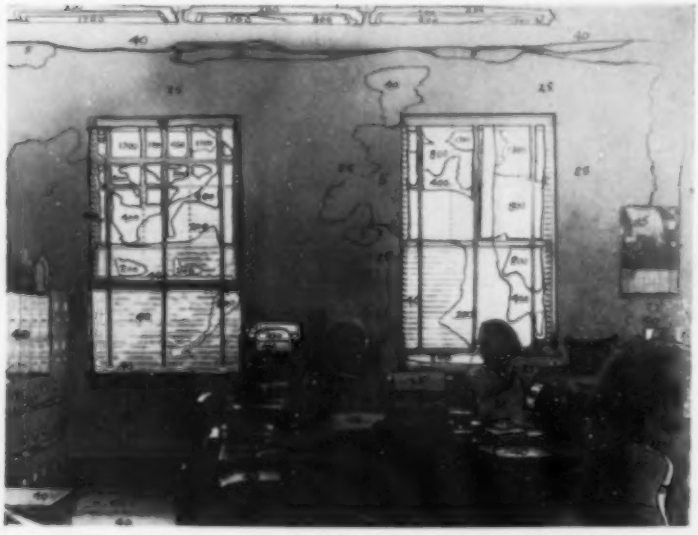

Figure 1 ►

Figure 2. Brightness contours shown in Figs. 1A to 1F traced on a normal print of the stenographic area. (Left.)

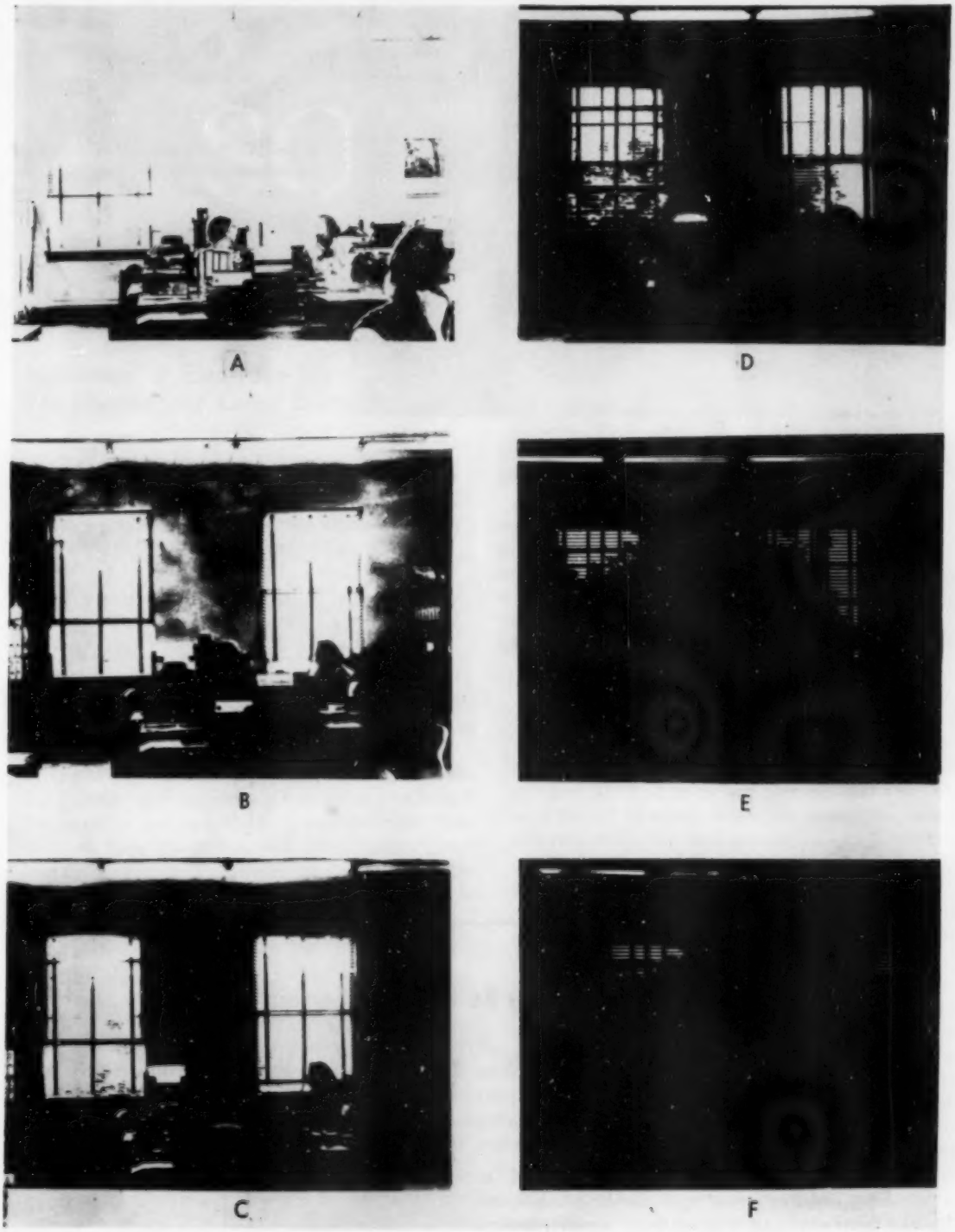

Figure 1. Brightness contours recorded for the stenographic area. The values of the contours in the photographs are 5, 25, 40, 200, 400, 1700 footlamberts for Figs. 1A to 1F respectively.

Figure 3. Multiple exposure print of brightness contours recorded for the stenographic area. Here the several contours were printed in register on the same piece of paper.

measured both immediately before and while the scene was being photographed.

The results obtained can be presented in any one or all of three ways. One is to present a series of photographs each showing a contour of brightness (Figs. 1A to 1F). Another method is to report the brightness contours shown in Figs. 1A to 1F by tracing them onto a normal photograph of the scene (Fig. 2). The third method involves presenting the contours of equal brightness as shades of gray in a single photograph (Fig. 3).

Considering the variety of objects, specularly reflecting surfaces and the wide range of brightnesses that may exist in large area scenes, this technique should prove a valuable tool in daylighting surveys.

(Abstract of I.E.S. Conference Paper No. 28)

Applications for Retired Membership

By action of the membership of IES, retired membership classifications are available to those members qualified. Privileges in these grades, earned by long membership in the Society, include reduced annual dues ($5.00) with the continued receipt of all Society mailings including ILLUMINATING ENGINEERING. Classifications are known as Member, Retired; Fellow, Retired; Associate Member, Retired.

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SOURCES

Influence of Electrode Materials On Fluorescent Lamp Discoloration

A. W. Wainio

F. M. Craven

IT HAS BEEN found that electrode or lead wire materials in fluorescent lamps exhibit a much greater effect on end discoloration than previously realized. This paper describes the various types of end discoloration encountered, why they occur, and how end spotting in particular can be affected by changes in electrode material. A more desirable lead wire material for reducing the incidence of wall spots is suggested and described.

The theory that metallic barium, released from the cathode and concentrated at certain bulb wall locations by the electrode field, combines with mercury to form spots does not adequately explain certain observations made in studies of lamp discoloration. Spots do not always occur in lamps in which metallic barium is released. Analysis of spots always indicates the presence of lead wire material in addition to mercury and barium. Use of different electrode materials results in widely different frequency and severity of spot formation in lamps which are otherwise identical in design and processing.

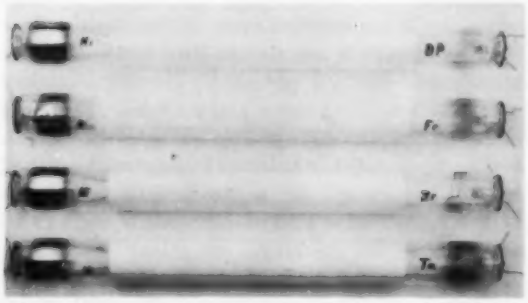

Figure 1. Sputtering of nickel and other materials. The lead wires in these tubes were sputtered by a five milliampere a-c current in mercury vapor and two millimeters of argon for three minutes.

The following mechanism is believed to offer a more adequate explanation of the effects observed. Barium released from the cathode and deposited on the bulb wall ordinarily combines with gaseous impurities present in the fill gas or on the phosphor surface, resulting in a deposit causing no noticeable discoloration. The nucleus of spot formation is an amalgam of mercury and material from the lead wires or from other metallic electrode elements electrically connected to the cathode and relatively close to it. As this amalgam grows in size, barium is deposited on it and becomes a part of the amalgam. With barium present the mercury concentration increases due to the strong affinity of mercury for barium and a dense spot results. According to the above theory sputtering characteristics of elec-

AUTHORS: Westinghouse Electric Corp., Bloomfield, N. J.

trode materials will have a large effect on spot formation in fluorescent lamps, and this is found to be the case.

Fig. 1 illustrates the deposits obtained by sputtering lead wire materials with a glow discharge of five milliamperes for three minutes. While this cannot be considered a measure of sputtering rates, it does illustrate relative resistance of materials to sputtering at a glow current which can occur in fluorescent lamps.

The superiority of certain lead wire materials over nickel relative to sputtering, as illustrated in Fig. 1, was confirmed by other tests and led to the conclusion that use of a material other than nickel (or nickel-plated iron) would result in reduction of spot formation in fluorescent lamps.

Black-plated iron emerged as the most practical material for use as lead wires due to its low cost, availability, workability, adaptability to available equipment, mechanical and chemical stability and its beneficial effect in reducing end discoloration. The term describes a high purity grade of iron processed into the desired form (such as wire for use in fluorescent lamp lead wires) and electroplated at high current density in a bath containing chromic acid and Vanadium salts. The plating, consisting of a deposit of about 0.00004 inch in thickness of finely divided chromium and Vanadium metals and their oxides, has good adherence, corrosion resistance, resistance to sputtering, high emissivity and good electrical conduction. Its color varies from dull black to jet black, hence the name black-plated iron.

(Abstract of I.E.S. Conference Paper No. 26)

Measurement of

Mercury Lamp Current Crest Factor And Its Effect on Lumen Maintenance

E. C. Martt

R. J. Smith

THIS PAPER compares four of the most promising methods of measuring lamp current crest factor (ratio of peak to RMS current) to determine accuracy, ease of measurement and equipment expense. Results of a test showing the effects of current crest factor on lumen maintenance for 400-watt mercury lamps are also reported.

The first and most accurate method to determine crest factor uses a magnetic oscillograph to reproduce the current wave shape on light-sensitive paper. The height of this wave trace is measured accurately at equal intervals (10 to 20) on a special measuring board, and from these measurements the crest factor is calculated according to Fig. 1. This method has an accuracy of about 1 per cent and is recommended as a standard. The second method uses the same magnetic oscillograph and measuring board, but an ammeter is used to measure the RMS current, and the trace height in amperes is determined by trace measurement. From these values the crest factor is calculated. This method has an accuracy of about 2 per cent. The third method uses a peak-reading meter and an RMS meter, and the fourth replaces the peak-reading meter with an oscilloscope. Neither the third nor fourth method is accurate enough for a standard, but they are both acceptable for many requirements and can be used for routine checking.

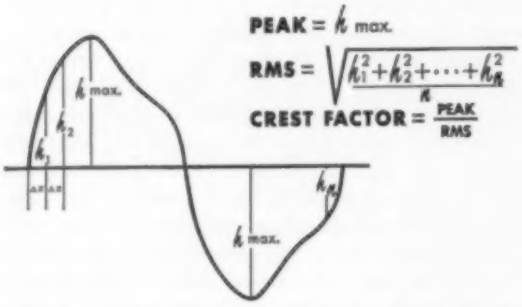

Figure 1. Method of measuring wave shape and calculating crest factor.

To determine the effects of current crest factor on lumen maintenance, thirty 400-watt, clear, quartz arc tube, mercury lamps with a range of

AUTHORS: Large Lamp Dept., General Electric Co., Cleveland, Ohio.

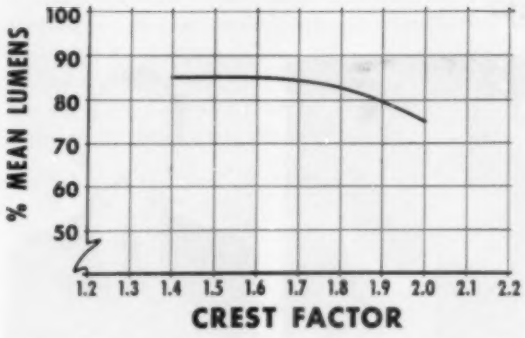

Figure 2. Per cent mean lumens for 6000 burning hours as a function of crest factor for horizontal operation adjusted for average lamps.

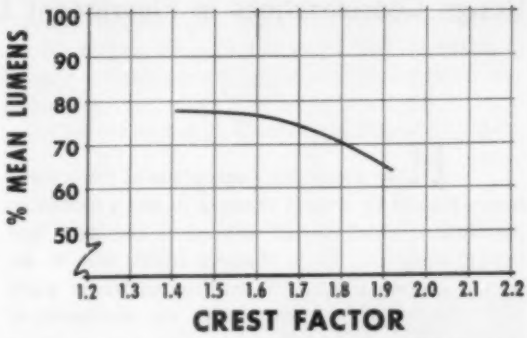

Figure 3. Per cent mean lumens for 6000 burning hours as a function of crest factor for vertical operation adjusted for average lamps.

lamp voltages were selected and burned on a series of four stabilized and one non-stabilized ballast. Lamps were burned at 10 hours per start on vertical-burning industrial luminaires and on horizontal-burning street lighting luminaires. Lamps were photometered periodically and per cent mean lumens for 6000 hours of operation determined. Resultant data were analyzed to check the effects of current crest factor, ballast type, luminaire type, and position of operation. Significant correlation was found between current crest factor and mean lumens for each luminaire condition.

The data indicate a decreasing per cent mean lumens with increasing current crest factor, and curves are plotted showing these effects. The curves through the actual test data are adjusted to develop curves applicable to lamps of average performance. This is readily accomplished for the 10-hour-per-start street lighting luminaire condition as shown in Fig. 2. Some uncertainty remains in the five hour-per-start industrial fixture curve shown in Fig. 3 because the test lamps were operated at ten hours-per-start. The curves relating maintenance and current crest factor are evaluated on a cost-of-light basis.

(Abstract of I.E.S. Conference Paper No. 15)

Internal Reflector Projection Lamps

J. M. Harris

INCANDESCENT projection lamps have commonly required external reflector assemblies and external condensing lens systems for the optical train necessary for film projection. When 8 mm projectors are considered, the physical space requirements for the necessary accessory equipment may be excessive. For simplicity of design as well as for increased optical efficiency, there has been considerable interest in the development of projection lamps that are compact and inclusive in design so that projector optics can be simplified.

A new 150-watt projection lamp specifically designed for 8 mm projectors has been developed. A carefully designed metallic reflector mounted within the projection bulb so efficiently controls the flux from a compact precision-placed filament that an external condenser lens is not required. As a consequence, a 150-watt lamp structure is capable of filling an f/1.5 optical system and producing roughly 100 screen lumens (without shutter). This is approximately equivalent to the screen illumination from conventional 500-watt lamps in the usual optical system.

(Abstract of I.E.S. Conference Paper No. 19)

AUTHOR: Sylvania Electric Products Inc., Salem, Mass.

Design Considerations in Fluorescent Lamps

George A. Meyers

F. M. W. Strojny

HIGH FREQUENCY operation of fluorescent lamps results in several changes in lamp operating parameters which are of interest to the lamp and circuit designer. These changes enable him to design a system which will realize maximum gains from the lamps, consistent with the economics of the rest of the lighting system.

With lamps operating at constant current, some loss in lumen output is experienced below approximately 2500 cycles, but a compensating increase in lamp operating current can be tolerated. The greatest gains in output and efficiency are obtained at the highest practical frequency at which the lamps can be operated. Improved lamp voltage waveshape with frequency, as shown in Fig. 1, results in an increase in lamp power factor and facilitates circuit calculations.

Of particular interest is the reduction in electrode loss with high frequency operation. Use of cathode heat, as in rapid-start lamps, yields a further reduction in electrode loss. This suggests improved life and discoloration beyond that of 60-cycle ratings, and tolerates an increase in lamp current up to 50 per cent for greater light output.

The open-circuit voltage that is required to start instant-start or rapid-start types tends to increase with frequency, as shown in Fig. 2, to as much as 20 per cent above 60-cycle values. It is evident that the circuit designer should obtain recommended values for the particular lamp, frequency, and other conditions to be encountered.

A substantial reduction in the radio-frequency interference generated by lamps is achieved at high

AUTHORS: Sylvania Electric Products, Inc., Danvers, Mass.

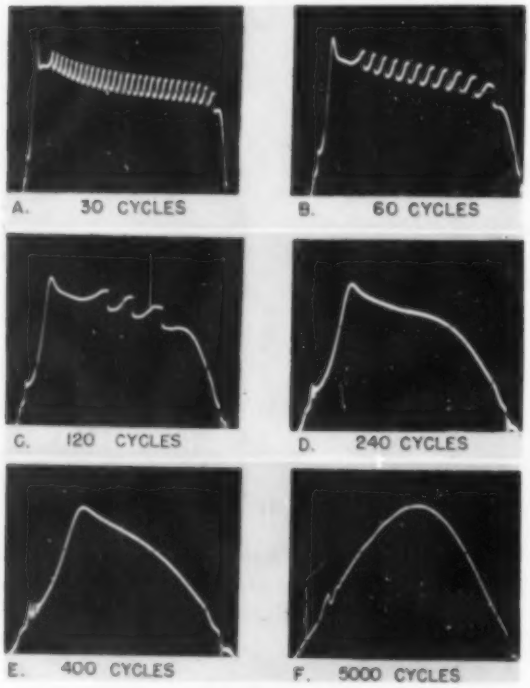

Figure 1. Lamp voltage waveshape. Typical oscillograms of lamp voltage of T12 lamps operated at several frequencies on inductive ballasts.

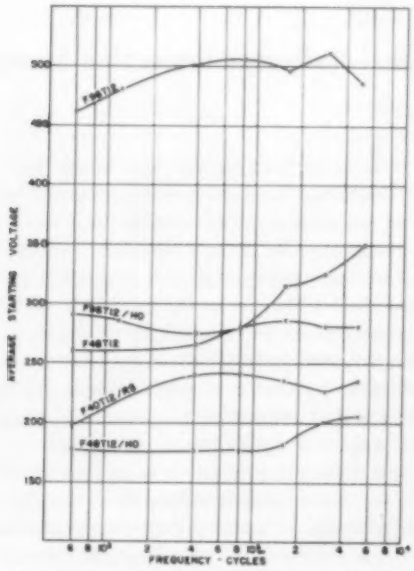

Figure 2. Starting voltage vs. frequency. Measured at room temperature with sine wave voltage source. Rapid start cathodes heated at 3.6 volts.

frequencies, with further gains indicated for rapid-start types, so that radio-frequency interference is no longer a problem.

Maximum gains from high frequency operation are obtained at the highest frequency at which it is practical to operate. Sixty-cycle ratings cannot be used but must be revised for the particular frequency, circuit, and operating parameters under consideration. No evidence was found, however, to justify a lamp specifically designed for high frequency service.

(Abstract of I.E.S. Conference Paper No. 23)

Effects of High Operating Temperature On the Lamp Envelope

F. A. Loughridge

IT HAS BEEN known for many years by the glass industry that the practical strength of glass is largely dependent upon the condition of the surface. Internal break origins are quite rare, and where they do occur can nearly always be attributed to a severe inclusion.

Conditions present during operation of many lamps are such that deterioration of the glass is accelerated. The presence of heat, moisture and in some cases chemical vapors, all tend to bring about a reduction of tensile strength of the glass surface, which may result in lamp failure. Transient stresses present during the heating and cooling of the lamps may exceed the tensile strength of the surface and result in fracture of the glass.

The purpose of this paper is to discuss the means of detecting this type of failure, the mechanism involved and corrective measures. Tests included investigation of the cause of failures of those types of mercury vapor lamps which have a soda lime glass outer bulb or envelope; indications were that one type of failure is due to physical deterioration of the glass. Lamps were also examined at various stages of life, and it was found that minute cracks start to appear after approximately 2500 hours burning and they occur only in lamps using a soda lime glass outer bulb. Lamps made with boro-silicate or hard glass did not develop the crazing.

There has been some thought that water evolu-

AUTHOR: Sylvania Electric Products Inc., Salem, Mass.

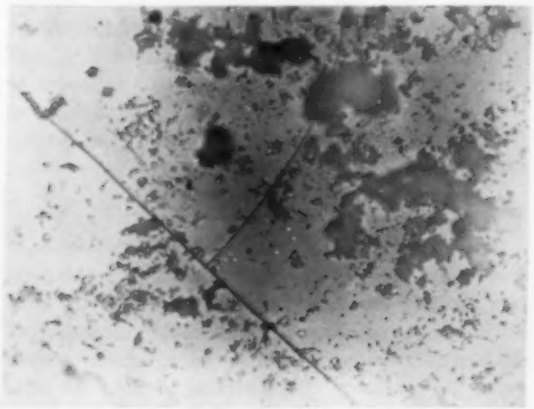

Figure 1. Photomicrograph of surface of mercury vapor lamp which has burned over 7000 hours. Deposits of crystalline weathering products and surface cracks are readily apparent on outer surface of lime glass bulb.

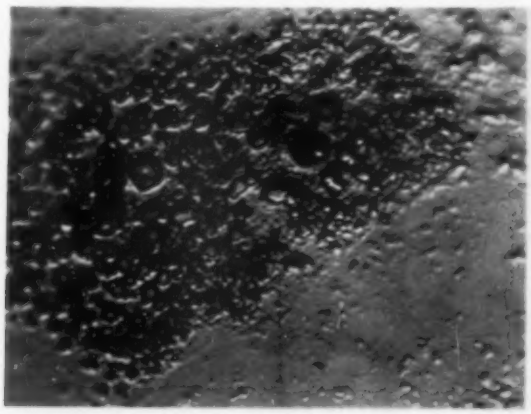

Figure 2. Photomicrograph of another lime glass bulb from a mercury lamp burned over 7000 hours. Surface has been cleaned with hot water and the severe pitting resulting from weathering is evident.

tion from the hard glass bulb would be detrimental to arc tube life. In practice, this has been no problem; lamps made with this glass have been operated beyond rated life with excellent performance characteristics.

No matter what type of glass is used, careful handling of the lamp should be practiced to avoid severe abrasion of the outer surface, and it should not be subjected to severe temperature gradients. In installations where high humidity, high temperature, or chemical vapors are present, the hard glass bulb is most desirable for reliable performance.

(Abstract of I.E.S. Conference Paper No. 16)

Self-Ballasted Vapor Lamps— New Basic Design and New Improved Types

Herbert S. Strauss

Wolfgang E. Thouret

THE INCANDESCENT-fluorescent-mercury vapor self-ballasted lamp utilizes all three fundamental physical effects of electric light production in one self-contained unit. It is a well-balanced combination of three familiar elements: an incandescent filament, a mercury vapor quartz arc tube, and a fluorescent substance converting ultraviolet into visible radiation. But it actually represents a fourth light source with certain useful and advantageous characteristics that cannot be found together in any of the other three lamp types.

Self-ballasted mercury lamps are compact units like incandescent or mercury vapor lamps. They have undelayed light output when switched on and they do not require an external ballast. Their life is much longer than that of incandescent lamps and similar to that of mercury vapor and fluorescent lamps. Their luminous efficiency is much higher than that of filament lamps but lower than the efficiency of mercury vapor and fluorescent sources. Their red color rendition can be similar to daylight and has a certain degree of flexibility.

In the first part of the paper, basic design data for self-ballasted lamps are presented in order to give a complete picture of their possibilities and limitations. The second part describes the characteristics of some practical lamp types.

AUTHORS: Duro-Test Corp., North Bergen, N. J.

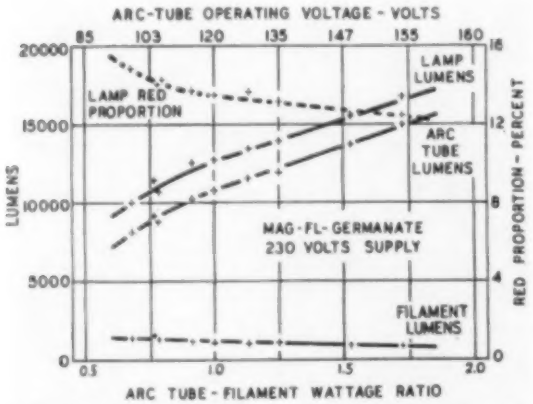

Figure 1. Lumen output and red proportion of 450-watt self-ballasted lamps as a function of arc tube/filament wattage ratio, showing contributions of the component light sources. Supply voltage, 230 volts, magnesium-fluorogermanate phosphor, BT-37 bulb.

Basic Design Data

The main problem arising in connection with the design of self-ballasted lamps is how the total lamp wattage is to be distributed between the mercury vapor discharge tube and the incandescent filament. In order to achieve an optimum over-all luminous efficiency, it is desirable to make the ratio between arc tube wattage and filament wattage as great as possible. Two factors have to be observed in determining this ratio: (1) the desire to achieve a satisfactory color rendition, *i.e.*, a sufficient amount of red light output, and (2) the necessity

TABLE I — Data of Self-Ballasted Lamps with Phosphor.

Wattage	Nominal Supply Voltage	Operating Current amps.	Starting Current amps.	Average Initial Lumens	Average Lumens / Watt	Approx. Red Proportion %	Outer Bulb	Base	Max. Over-all Length Inches	Light Center Length Inches
450	208	2.35	3.3	13000	29	13	BT37	Mogul Scr.	11 ½	7
450	230	2.15	3.0	13000	29	13	BT37	Mogul Scr.	11 ½	7
750	208	3.7	5.2	22500	30	11	R57	Mogul Scr.	12 ½	8 ½
750	230	3.4	4.7	22500	30	11	R57	Mogul Scr.	12 ½	8 ½
1750	208	8.7	12.2	59000	33.5	13	BT56	Mogul Scr.	15 1/16	9 ¾
1750	230	7.8	11.0	59000	33.5	13	BT56	Mogul Scr.	15 1/16	9 ¾

NOTE: When switched on, the lamps have approximately 15 per cent higher than normal lumen output for a period of ½ minute. If extinguished, they require four to five minute cooling time before they will restrike.

of reliable arc tube operation even under great fluctuations of the supply voltage.

Self-ballasted lamps of constant over-all wattage designed for a given supply voltage were equipped with mercury arc tubes of varied operating pressures and voltages. The ballast filaments were adjusted to every arc tube in order to consume the exact difference between total lamp wattage and individual arc tube wattage. In Fig. 1 we find the lumen output and the total red proportion* of 450-watt, 230-volt lamps in BT-37 bulb with magnesium fluorogermanate phosphor, as a function of the arc tube/filament wattage ratio. Besides the total lumens, the lumen contributions of the arc tube and the filament alone — both when operated in the phosphor coated bulb — are shown. As expected, the over-all luminous efficiency increases considerably with growing arc tube/filament wattage ratio. The over-all red proportion decreases but remains virtually constant and above 12 per cent at greater wattage ratios. Thus, from the point of view of satisfactory color and luminous efficiency, the highest possible wattage ratio should be chosen for self-ballasted lamps. The upper limit of the wattage ratio is determined by the highest extinguishing voltage of the arc tube that is compatible with reliable lamp operation. This wattage ratio is found to be between 1.2:1 and 1.3:1. The corresponding lumen ratio is at least 5:1 and may amount to as much as 10:1 if filaments of very low efficiency are used.

*Red proportion is the percentage of the total lumens that can be measured through a particular red filter.

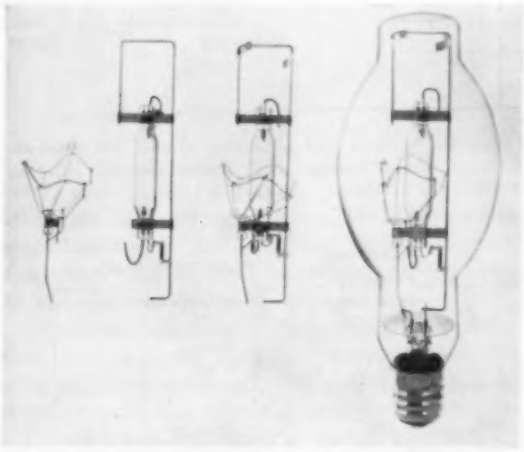

Figure 2. Inner structure of 450-watt self-ballasted lamp. From left to right: Filament assembly, mercury vapor arc tube assembly, filament assembly joined to arc tube assembly, complete lamp.

Practical Lamp Types

Three practical types of self-ballasted lamps have been developed so far. A 750-watt lamp in R-57 bulb has been commercially available for some time under the trade designation "Fluomeric" and has met with considerable success in practical use. Two new types of 450-watt (BT-37 bulb) and 1750-watt (BT-56 bulb) have been designed recently and a greater number of experimental lamps have been made. Table I gives the main characteristics of the three lamps. The two new types are developed for 208- and 230-volt power supplies only, while the 750-watt lamp is also available in a special design for 120 volts. All three types are equipped with hard glass bulbs in order to withstand thermal shock and chemical attack over the long rated life of the lamp.

The inner structure of the new types and the assembly of their components is illustrated by Fig. 2. The filament is mounted on its supports and connected to its leads in a separate procedure similar to the customary practice in the manufacture of incandescent lamps. The mercury vapor arc tube is also mounted and connected separately in its support frame together with the starting resistor. The filament assembly is then joined to the arc tube assembly and both together are connected to the stem and sealed into the bulb. In the finished lamp, the filament is arranged symmetrically around the center of the arc tube, providing an optimum blending of the light from both sources.

(Abstract of I.E.S. Conference Paper No. 14)

Theodore C. Retzer

Circuits for Short-Arc Lamps

In recent years the development of high pressure short-arc mercury lamps has necessitated the design and development of special circuits for proper operation of these lamps. Like most vapor discharge lamps, short-arc mercury lamps require auxiliary devices to initiate the arc and limit the lamp current to design values. The circuits described in this paper are designed for the operation of short-arc lamps on 60-cycle alternating current power of 110-125 volts, which is the primary supply used for these lamps in the United States today.

Short-arc mercury lamps like the SAH-250-A shown in Fig. 1 have a single-ended current carrying leads construction and outer bulb. These lamps are filled at low pressure with an ionizable gas such as argon. They must be at room temperature when started so that the temperature and pressure within the lamp is low enough to permit a starting voltage of a few hundred volts to break down the gap between the electrodes. The circuit shown in Fig. 2 develops a starting voltage of 250-300 volts, and will satisfactorily start a cold low-pressure lamp of the above design in less than three seconds. If one attempts to start a hot lamp on this circuit, the voltage is not sufficient to cause arc-over in the outer bulb or socket. However, the lamp will not start until it has cooled sufficiently to permit 250-300 volts to start it.

Lamp construction with diametrically opposite current carrying leads permits the use of high-voltage pulse circuits for starting and restarting after a power failure. Short-arc mercury lamps like the SAH-1000-A shown in Fig. 1 can, therefore, be restarted when hot. Other lamps having this double-ended construction are mercury-xenon and xenon short-arc lamps which are generally filled to one or more atmospheres of xenon gas. They require high-voltage pulse circuits for starting at any temperature.

The circuit used to start short-arc lamps having diametrically opposite current carrying leads under any pressure and temperature condition is shown in Fig. 3. It consists essentially of a spark

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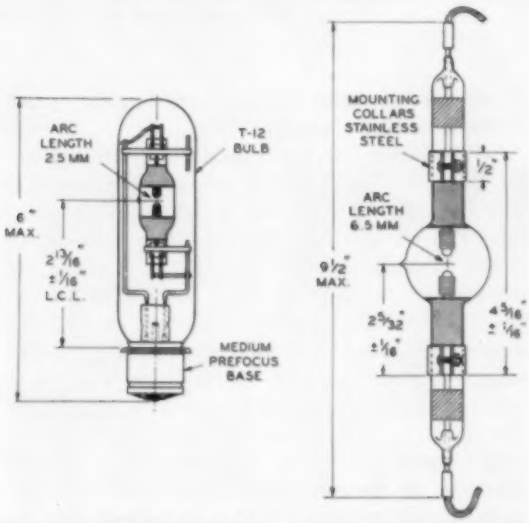

Figure 1. Two types of short-arc mercury lamps. (left) 250-watt lamp with single-ended current carrying leads, (right) 1000-watt lamp with diametrically opposite current carrying leads.

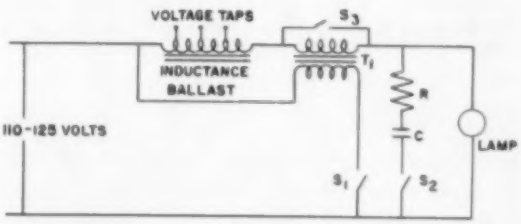

Figure 2. Starting and operating circuit for short-arc mercury lamps having single-ended current carrying leads.

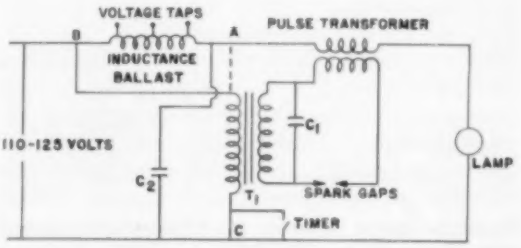

Figure 3. Starting and operating circuit for high pressure short-arc lamps.

gap oscillator feeding a pulse transformer which delivers approximately 50,000 volts to the lamp. However, it is essential that the design of the starting circuit components permit the spark gap oscillator to deliver 10 to 20 pulses per half cycle of the 60-cycle voltage wave. The starting circuit must first develop sufficient voltage to break down the discharge between the lamp electrodes. The high voltage must have several pulses which occur at a time corresponding to the interval between the reignition and extinguishing point of the 60-cycle wave. These high-voltage pulses occurring during this time interval result in 60-cycle current flow which heats the lamp electrodes to thermionic emitting temperature, and the lamp becomes self-maintaining on the applied line voltage. From a practical standpoint, it has been found that a voltage of 50,000 volts having 10 to 20 pulses per half cycle is needed. Experience has shown that proper circuit component design requires that the high-voltage pulse be applied not more than three seconds for satisfactory lamp starting on a 115-volt line. This is important because prolonged use of high voltage results in premature darkening of the lamp bulb due to positive ion bombardment of the tungsten electrodes.

A new circuit with less critical manufacturing tolerance of the circuit components to give the required 50,000 volts with a large number of pulses is described in this paper. A method for predicting the reliability of performance of starting circuits and for differentiating a good circuit from an inadequate circuit is also discussed.

Short-arc type lamps are still in their infancy and applications are continuously being found where they can be used to advantage. Undoubtedly, as in the past, future short-arc lamp designs and applications will result in the design of new circuits to fulfill these requirements.

(Abstract of I.E.S. Conference Paper No. 17)

New Combustible for Photoflash Lamps

L. F. Anderson

PRIOR TO 1958, all photoflash lamps except for one relatively low production type were filled with finely dispersed, substantially pure aluminum in an oxygen atmosphere. Progress in aluminum-oxygen lamps, along with equipment and film, satisfied most important photographic requirements, as indicated below.

(1) *Miniaturization* — Substantial size reductions were achieved through improved volumetric efficiency, but additional illumination was needed for high speed and color photography.

(2) *Maximum Utilization and Uniformity* — Status was adequate, but improvement was desirable, particularly in color.

(3) *Acceptable Color Balance* — Self-contained filters yielded good color balance except for miniature daylight type.

(4) *Low Ignition Energy — Minimum Inadvertent Flashes* — Ignition levels were adequate and inadvertent flash frequency was reduced to less than 1 per 100,000.

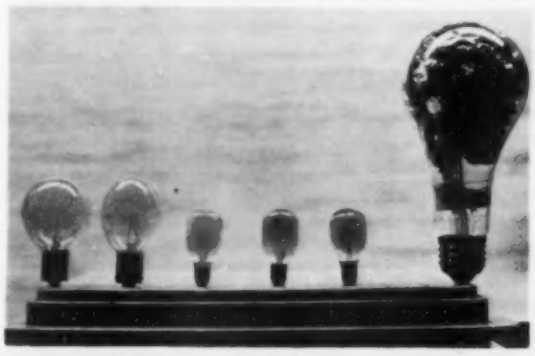

Figure 1. Physical comparison of midget, miniature and foil lamps.

AUTHOR: Sylvania Electric Products Inc., Montoursville, Pa.

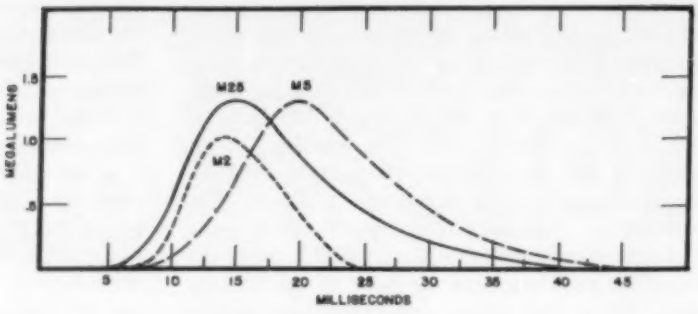

Figure 2. Time-intensity characteristics of M2, M25 and M5 miniature lamps.

(5) *Rapid, Positive Insertion and Removal* — Latching devices and semi-automatic ejectors facilitated usage. Miniature base further simplified loading.

(6) *Containment of Reaction within Vessel* — Despite increasing volumetric efficiences, stronger bulbs and controlled combustion resulted in better containment.

(7) *Low Cost* — Substantial real cost reductions were achieved through design changes and automation.

Additional increases in volumetric efficiency appeared limited. No substantial increase in luminous efficiency appeared feasible. A new system offered the only frontier.

Detailed thermodynamic investigations of other systems were conducted prior to empirical testing because of the difficulty of reducing most elements to the required size for proper dispersion. Many scarce, costly and uncontrollable reactants were tested in attempts to break through the limitations of the aluminum-oxygen system. The following factors were found to affect luminous efficiency: heat of formation, dissociation temperature, reaction speed, selective radiation and energy absorption by reactants and compounds.

The zirconium-oxygen system yielded highest efficiencies with thorium-oxygen next. Although attainment of required zirconium ductility proved a formidable obstacle, satisfactory foil was finally obtained. Pure reactor grade zirconium was used to attain highest efficiencies. Filamentary combustible was obtained from foil approximately 8 inches wide and 0.001 inch thick, cut into strips approximately 0.0013 inch wide.

The following advantages are obtained, compared to the aluminum-oxygen system:

(1) More than 100 per cent increase in volumetric efficiency;

(2) For the same initial oxygen pressure, reduced bulb heating and peak pressure permitting increased charges;

(3) Improved timing uniformity;

(4) Broader time-intensity characteristic;

(5) Reduced susceptibility to inadvertent ignitions from microwave fields and static discharges.

Four zirconium lamp types have been developed: M25 and M25B types, adapted to box cameras and having nominal peak time rating of 15 milliseconds; M5 and M5B types, adapted to high speed cameras and designed to peak at 20 milliseconds.

Fig. 1 shows a physical comparison of midget lamps #25 and #5; miniature lamps M2, M25 and M5; and a discontinued #20 lamp; in that order. Fig. 2 shows comparative time-intensity characteristics of the miniature types. Output of zirconium lamps is 16,000 lumen seconds compared to 7,000 lumen seconds for the M2. Output of fully compensated B-types is 8,500 lumen seconds compared to 6,000 lumen seconds for the partially compensated M2B.

Effective illumination is equivalent to midget types, four times larger, and will permit substantial size reductions of photoflash accessories. Users of miniature equipment can now obtain greater depth of focus, use higher speeds and increase subject distances and group coverage. Where formerly only threshold exposures could be made in color at acceptable subject distances, fully exposed photographs can now be made with miniature lamps.

This development is regarded as the most significant in the 28-year history of photoflash. It represents the first substantial gain in luminous efficiency and the improvement in volumetric efficiency exceeds that of combined previous history.

(Abstract of I.E.S. Conference Paper No. 18)

October IE To Feature Photos of IES Officers

Photographs of the National Officers of IES and of as many as possible of the Section and Chapter Chairmen will be a feature of the October issue of IE.

STREET LIGHTING

D. E. Husby

Design and Evaluation of

High Utilization Fluorescent Street Lighting Luminaire

THE PRESENT fluorescent street lighting luminaire designs have been dictated by the physical characteristics of fluorescent lamps and their ballasting equipment. The optical designs have an elementary form, that of placing the lamp normal to the flow of traffic, thus placing the lamp's maximum candlepower output in line with the flow of traffic. This approach has served the purpose of introducing fluorescent sources to street lighting and has succeeded in providing acceptable lighting in some areas. However, this type of design has certain undesirable features which limit its application and the further refinement of its optical performance.

The transverse type of luminaire has inherent weaknesses. The street-side utilization is low because of the orientation of the lamps and reflectors with respect to the street, the across-the-street illumination is poor because of orientation of the lamps and reflectors, the mechanical construction is clumsy and severely stressed because of orientation, and luminaire brightness is becoming more and more objectionable as higher loaded lamps are introduced for outdoor service.

This paper deals with an approach to fluorescent street lighting design which increases the street-side coefficient of utilization, increases the across-the-street illumination and improves the uniformity ratio by adopting a parallel orientation of the lamps and reflector with respect to the flow of traffic.

In conjunction with this orientation, it is realized that little control is possible by means of reflection of the lamp's output in the longitudinal dimension. Therefore, control in this direction is possible by refraction. By use of a refractor for this control area, greater uniformity, better cut-off and more comfort is achieved. This evolutionary change follows the development of incandescent street lighting very closely.

Table I shows that this parallel approach offers increased utilization comparable to increases found in incandescent street lighting evolution. On the basis of lumens per watt utilized in a street area, the parallel approach even now compares very favorably with the highly efficient mercury vapor luminaire and far surpasses the conventional transverse type. It is predicted that in not too many years, this approach will yield even greater economies than the mercury vapor type luminaires.

Above all, this approach reduces the luminaire brightness remarkably as compared to the conventional transverse type. This is illustrated by motion pictures of actual installations which were taken using one camera setting, one speed, and one film.

The advantages gained using the parallel approach indicate a major advance in the fluorescent street lighting art and indicate that adoption of this principle will yield a luminaire which will surpass the enviable position of efficiency now enjoyed by the mercury vapor luminaire and at the same time, provide a luminaire which far surpasses the mercury vapor luminaire in comfort and range of application.

(Abstract of I.E.S. Conference Paper No. 34)

AUTHOR: Lighting Division, Westinghouse Electric Corp., Cleveland, Ohio.

R. M. Swetland

K. D. Tobin

A Demonstration Laboratory For Outdoor Roadway Lighting

INDOOR laboratory tests, measurements and calculations while indispensable to the street lighting industry are, however, inadequate for a complete and accurate appraisal of an installation. The industry has long recognized the need for a full-scale outdoor demonstration and research "test track" such as now exists at Hendersonville, N. C. This facility, with the visual appraisal it permits, is of particular value to interested laymen who may not be too familiar with all the technical factors of roadway lighting, but to whom "seeing is believing."

Many advantages have resulted from the construction of this "Crossroads of Light" demonstration. Among them are the following:

(1) All observations are made from one vantage point.

(2) Time and expense of visiting widely-scattered installations is eliminated.

AUTHORS: General Electric Co., Outdoor Lighting Dept., Hendersonville, N. C.

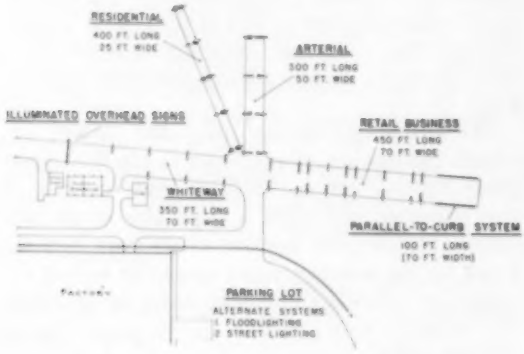

Figure 1. Plot plan of demonstration streets.

(3) Alternate lighting systems can be instantly switched.

(4) Brightness appraisals of both asphalt and concrete pavements are possible.

(5) An opportunity for experimenting with new luminaire designs and conducting seeing evaluations with instruments is afforded.

The plot plan of this facility is shown in Fig. 1. Street widths of 70, 50 and 25 feet prevail. Both asphalt and concrete surfaces are used, as seen in Fig. 2. Approximately 140 luminaires, producing all five IES light distribution patterns are involved in the installation. Filament, mercury and fluorescent sources are used. Four types of poles are employed, namely steel, aluminum, concrete and wood. Calculated illumination levels from 0.1 to 6.6 footcandles average are obtained from a single given luminaire and lamp arrangement. With all circuits energized, the total generated light is approximately two and one-quarter million lumens; the total connected load is about 70 kva.

Power for the installation is distributed by a three-wire 120-240-volt network. A central control console actuates load relays at each pole. A majority of the circuits are underground.

Table I shows the luminaire and lamp arrangement for the four sections of the demonstration installation: residential, arterial, retail business and white-way.

Typical of the experimental projects being investigated at Hendersonville is the continuous-line-parallel-to-curb system involving 8-foot, T-12 fluorescent lamps in enclosed luminaires, suspended from a catenary above each curb along a 70-foot wide street. One hundred feet (linear) of roadway is lighted with this system.

Figure 2. Retail business section lighted by four-lamp (HO) six-foot fluorescent luminaries, 100-foot linear and opposite.

Figure 3. Night panorama of the outdoor roadway lighting facility, "Crossroads of Light."

To study effective roadway lighting from low-mounted parapet sources, enclosed luminaires with a single six-foot T-12 high output lamp have been arranged on approximately 12-foot linear centers at a four-foot height along one side of the roadway. The "Tee" luminaire arrangement, where three six-foot fluorescent luminaires are mounted on a single pole with two luminaires positioned parallel to the curb, is also being tried.

For the study of highway sign lighting, single-lamp fluorescent luminaires, mounted along both the top and bottom of signs, are being used. The top and bottom rows can be switched separately.

Over-all plans for automobile parking area lighting include both filament and mercury floodlighting from 60-foot towers as well as a fluorescent street lighting treatment involving 30-foot poles. The concrete-surface roadway has been sprayed with a water-soluble silicone solution for the study of pavement reflectance improvement.

Discomfort glare studies, with the aid of the Guth Discomfort Glare Evaluator, are being conducted and significant data are being accumulated. Also under investigation are the problems of roadway visibility in fog and visibility from automobile headlamps with and without an overhead fixed lighting system.

During the first full year of operation, a total of 65 different groups, approximately 1100 individuals, many from outside the United States, visited the installation. All were most favorably impressed. Visitor polls indicated that about 60 per cent of the observers favored illuminants producing true-color appearance of objects and people on any basis of approximate quantity of light used. Valuable information is being obtained on light color appraisals. The use of the complete outdoor lighting facility results in a better understanding of the relationship between what the laboratory photometer sees and what the human eye sees.

The "Crossroads of Light" is believed to be the most flexible and inclusive in scope of any such facility in the country today. All those interested in roadway lighting techniques and progress are cordially invited to visit this installation.

(Abstract of I.E.S. Conference Paper No. 33)

TABLE I — Luminaire and Lamp Arrangement.

	Residential Section	Arterial Section	White-Way Section	Retail Business Section
Number of basic lamp and luminaire types	6	7	2	3
*Range in lamp size	2500-7200	10,000-23,000	54,000-55,800	15,000-23,000
Linear spacing	100 and 200 feet 1 side	100 feet staggered	100 feet opposite and staggered	75 and 100 feet opposite and staggered
Mounting heights	24-28 feet	27-30 feet	31-34 feet	28-32 feet
**Average calculated footcandles	0.1-0.45	0.6-1.7	1.6-6.6	0.83-3.2

*Total rated lumens in luminaire.
**Initial values.

Walter M. Waldbauer

Highway Lighting Without Glare — A New Lighting Technique

THE TREMENDOUS growth in the number of vehicles on the road together with the increase in pleasure travel by the American public has substantially promoted the construction of freeways and limited access highways of the multi-lane dual roadway type. To achieve maximum safety, it is generally agreed that eventually these highways should be lighted.

This paper proposes that when factors such as visibility, glare, total annual costs and maintenance accessibility are considered, presently available highway lighting systems leave much to be desired.

AUTHOR: Lighting Division, Westinghouse Electric Corp., Cleveland, Ohio.

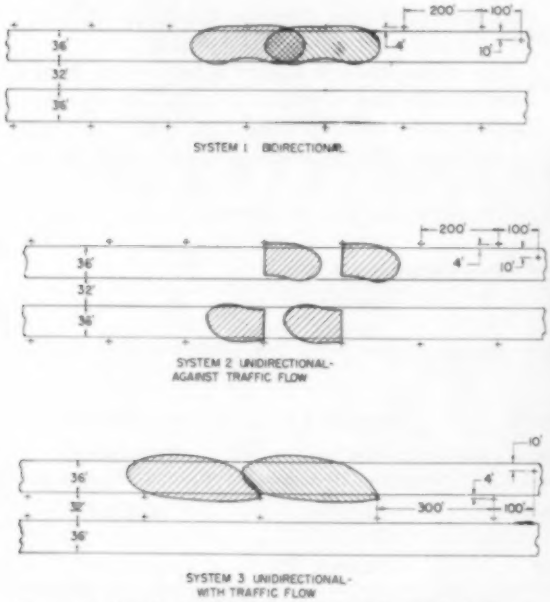

Figure 1. Luminaire arrangement for glare calculations.

Since highway driving is a continuous process without appreciable environmental change, it was felt that a design which achieved freedom from glare was of major importance. In addition, with poles at uniform spacing and with the car traveling at constant speed, the constant flashing of a glare source at regular intervals into the eyes of the driver is believed to be one of the major problems in highway lighting. This premise precludes the choice of a uni-directional system with the light source pointed towards traffic and precludes the use of a standard bi-directional type of street lighting luminaire.

Visibility of the type produced by the standard automotive headlight system is a result of vertical footcandles which reveal an obstacle or object to the driver by reflected glint or direct discernment. It is strongly believed that a lighting system which depended on another type of visibility, namely, silhouette discernment, for revealing objects, when used in combination with high beam headlights, would produce a lower over-all visibility rating for the combination and would tend to confuse the driver since his base of judgment would not be constant. With this as an added factor, the choice of a luminaire which is uni-directional in nature with the maximum candlepower directed in the direction of traffic flow is clearly indicated.

The design of this uni-directional unit was based on a 30-foot mounting height with the luminaires located 4 feet to the left of the high speed lane, that is, poles located in the medial strip. Light source was to be the 400-watt E-H1 mercury vapor lamp. The lamp was mounted vertically, flashing a main parabolic reflector 20 inches in diameter. Distribution requirements were established so as to produce essentially uniform vertical footcandles on the order of one footcandle. A

Figure 2. Test installation with general purpose floodlight and open suburban units turned on.

prismatic lens combined with louvers modified the parallel beam of the reflector into a sharp cut-off asymmetric distribution whose lateral spread towards the opposite roadway was the bare minimum. Lateral control of the distribution was of paramount importance, since light from the luminaire into the opposite roadway would be, in itself, an offending glare source.

Calculations of disability veiling brightness were made comparing this uni-directional system with standard bi-directional mercury and fluorescent systems and resulted in reductions in DVB factors ranging from 62½ to 82½ per cent in favor of a uni-directional system aimed in the direction of traffic flow.

Throughout this paper, the need has been stressed for evaluating a highway lighting system based on providing good visibility while maintaining comfort at the highest practical level. Experimental installations have proven that this system can provide good visibility and obstacle discernment. In addition, it has been shown that with this proposed distribution, a system that is virtually free from glare can be achieved. While it is apparent that complete elimination of veiling glare cannot be expected in the first optical designs, it does exist as a goal. Certainly the end result, highway lighting without glare, is an objective that now appears obtainable.

(Abstract of I.E.S. Conference Paper No. 32)

Theoretical and Practical Light Distributions For Roadway Lighting

A. W. Fowle

R. L. Kaercher

TABLE I.

Width of Roadway	Average Horizontal Footcandles Mean	Maintained*	Ratio of Average to Minimum Horizontal Footcandles
30 Feet	1.04	0.83	3.6/1
40 Feet	0.93	0.74	3.9/1

*80 per cent Luminaire Maintenance Factor.

THIS PAPER is intended to provide a better understanding of the complex interrelationships of roadway lighting luminaire design and application aspects (Fig. 1). The authors believe that the basic problem of roadway lighting engineers is to create adequate visibility distance (the distance at which a given object of a given size and brightness contrast can be detected in order to take proper action to deal with it).

There has been much agitation recently for a criterion to specify illumination based on "roadway brightness" in place of the horizontal footcandle. The authors feel that until such time when sufficient brightness data is available, the average horizontal illumination and its uniformity is still the most practical criterion to use.

The paper also discusses a procedure for developing a complete luminaire candlepower distribution to meet pre-established intensity levels and the uniformity of horizontal illumination in a roadway lighting system. An example is shown, and results compared with those of existing luminaire distributions (Table I).

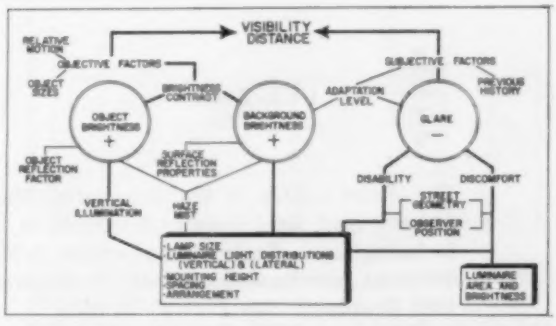

Figure 1. Relationship of controllable factors of lighting system and luminaire design with elements of visibility distance.

AUTHORS: Holophane Co., Newark, Ohio.

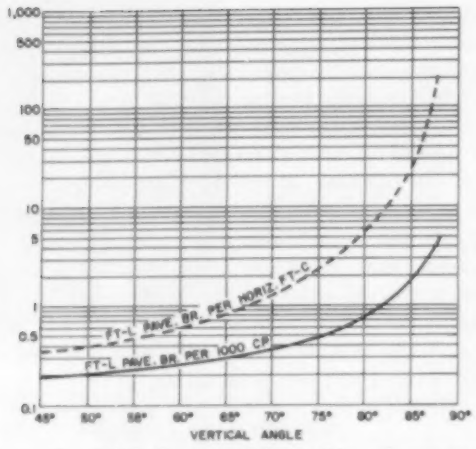

Figure 2. Solid Curve — Relationship of pavement brightness to vertical angle of candlepower emission of one light source. Candlepower remains constant. Dotted Curve — Relationship of pavement brightness to vertical emission angle for equal horizontal illumination from one luminaire. (Pavement surface was typical worn asphalt used by Reid and Chanon.)

Other considerations discussed are roadway brightness, disability veiling brightness (veiling glare) and discomfort glare. The relationship of these factors with the candlepower distribution (intensity and angle) and the viewing position of the observer is computed and discussed (Figs. 2 and 3). The first two factors are of major importance in the development of a luminaire candlepower distribution. Discomfort glare is of lesser importance since all recognized investigations show that it has no effect on the ability to see.

1. Reid, K. M., and Chanon, H. J.: "Evaluation of Street Lighting," *Transactions of the Illuminating Engineering Society*, Vol. XXXIV, No. 10 (December 1939).

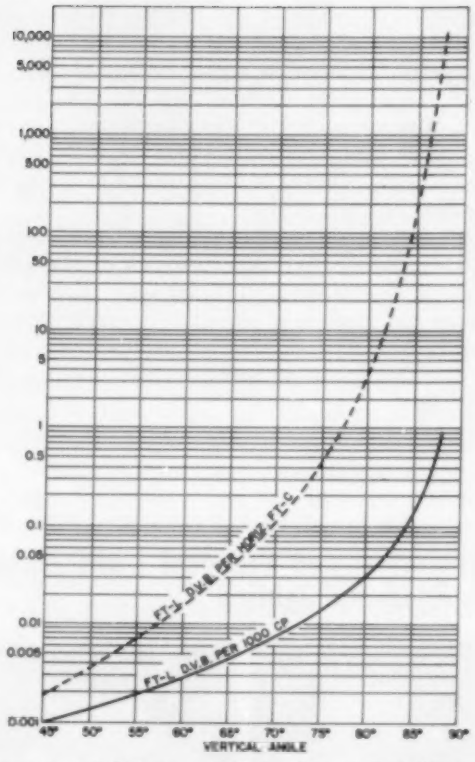

Figure 3. Solid Curve — Relationship of disability veiling glare to vertical angle of candlepower emission of one light source 100 feet from observer. Candlepower remains constant.
Dotted Curve — Relationship of disability veiling glare to vertical emission angle for equal horizontal illumination from one luminaire 100 feet from observer.

(Abstract of I.E.S. Conference Paper No. 31)

I.E.S. Emblem

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APPLICATIONS

J. S. Hamel

Integrated Ceilings for Illumination

INTEGRATION is a key word in the design and construction of modern air-conditioned buildings, and the need for integration of ceiling systems with lighting and air-conditioning systems may be a critical factor, not only in design affecting appearance, but also in design affecting cost. This paper deals with the economic aspects of integrated ceilings for illumination and some new application techniques of lighting, ceiling systems and air-conditioning.

The lighting system automatically becomes an important factor affecting costs of air-conditioning, as indicated in Fig. 1, which shows the relationship of lighting in watts per square foot and the resultant percentage of air-conditioning load caused by the lighting system. This points to the fact that a lighting load, for example, of 6 watts per square foot amounts to approximately 41 per cent of the cooling load.

With air-conditioning costs varying from $600 to $1200 per ton, and using the minimum cost, lighting costs evaluated in terms of refrigeration cooling would amount to a minimum of $246 per ton of refrigeration. Evaluating this figure to a cost per square foot, it can be shown that the lighting cost in terms of air-conditioning would be approximately one dollar per square foot for an average office. (This is based on approximately 250 square feet per ton of refrigeration.) In more expensive systems costing up to $1200 per ton, this cost per square foot could be doubled.

Obviously any saving that can be made in reducing the heat gain due to lighting can become an important economical factor in over-all cost of construction. In the integrated ceiling system described in this paper, the ballasts are removed from the air-conditioned space, with a 17 per cent saving in heat gain. This is illustrated diagrammatically in Fig. 2.

Application of high-output fluorescent lamps in offices to provide 100 footcandles and higher with

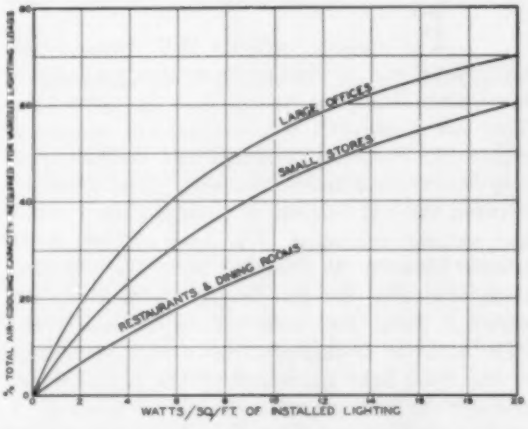

% TOTAL AIR-COOLING CAPACITY REQUIRED FOR VARIOUS LIGHTING LOADS
LARGE OFFICES
SMALL STORES
RESTAURANTS & DINING ROOMS
WATTS/SQ/FT OF INSTALLED LIGHTING

Figure 1. Effect of lighting load on air cooling capacity. (Reprinted by permission of the authors, from Sturrock, Walter, and Schutrum, Lester F., " AStudy of the Extraction of Heat from Fluorescent Luminaires in Air Cooled Rooms," ILLUMINATING ENGINEERING, Vol. LII No. 11, page 569 (November 1957).

AUTHOR: Consulting Engineer, Burbank, Calif.

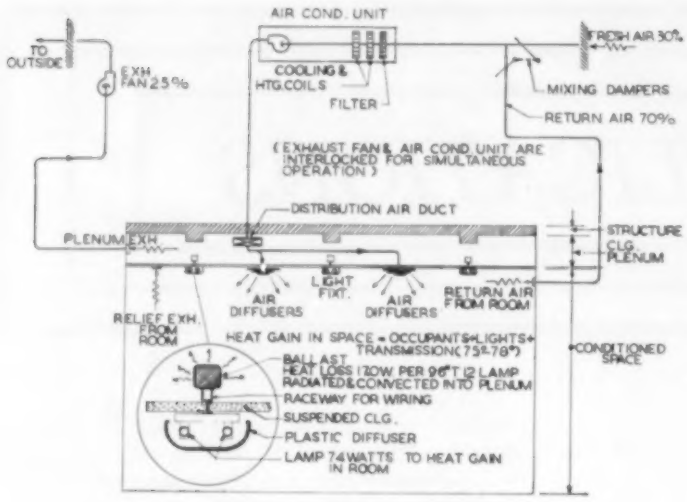


Figure 2. Relation of air-conditioning to lighting elements.

indirect systems of lighting through the use of integrated ceilings removes the ballast and its attendant noise and heat from the conditioned space, providing a practical and economical application of these new light sources for quality illumination.

There is much discussion today relative to ventilation of luminaires by forced air methods. It is obvious that by the removal of the ballast from the luminaire and the integration of the luminaire into the ceiling *and* air-conditioning system, a new field is opened for reducing air-conditioning costs, improving ballast life through lower ambient operating temperature and providing good quality illumination.

(Abstract of I.E.S. Conference Paper No. 38)

Economics of Fluorescent Reflector Lamps

C. N. Clark

N. F. Meyer

FLUORESCENT reflector (FR) lamps, originally developed in Europe have been available in the United States in several sizes for some time. They are electrically and mechanically similar to regular fluorescent (F) lamps and the two types may be installed interchangeably. The difference between them is that the FR lamps have a reflective coating, consisting of a layer of inert white powder between the phosphor layer and the glass bulb, extending the full length of the bulb and covering about two-thirds of its circumference. This reflective coating redirects a high percentage of the total light generated by the phosphor out through the non-reflectorized strip or opening. A small portion of the light is emitted through the reflector.

Testing and analysis indicate that fluorescent reflector lamps in general-lighting luminaires of the direct or direct-indirect types tend to deliver a higher percentage of their light output to the work plane than regular fluorescent lamps because:

(1) Their smaller upward component results in less light loss by trapping and reflector absorption, so that luminaire efficiency is higher.

(2) Their directional characteristics tend to give most luminaires a slightly higher flux ratio.

AUTHORS: General Electric Co., Large Lamp Dept., Cleveland, Ohio.

Figure 1. Mean candlepower distributions of a 2-lamp 40-watt closed-top industrial luminaire tested with F and FR lamps. "Clean" data are for clean lamps and luminaire. "Dirty" data are for reflector of 40 per cent reflectance, with dirt on lamps absorbing 30 per cent of upward light from lamps and 10 per cent of downward light. Numbers in parentheses are approximate lumen outputs of the luminaire under the conditions indicated, based on 2500-lumen F lamps and 2180-lumen FR lamps. With periodic cleaning of lamps and reflector, mean luminaire output with each lamp type would be some value between the values for "clean" and "dirty" conditions.

(3) Their directional characteristics modify the normal light distribution of direct-indirect luminaires, increasing the proportion of downward light.

(4) Their light output is less influenced by normal accumulation of dirt on the reflector (upper) side of the lamp.

(5) Their smaller upward component results in luminaire output being less influenced by accumulation of dirt on reflecting surfaces designed to redirect light downward.

On the other hand, these lighting advantages of FR lamps as compared to regular F lamps may be partly or entirely offset by one or more of the following facts:

(1) Light output of FR lamps is about 12 to 15 per cent lower than that of comparable F lamps of the same size and wattage due to absorption by the built-in reflector.

(2) FR lamps are inherently more expensive.

(3) The opening of the FR lamp is considerably higher in brightness than the brightness of comparable F lamps, which may lead to greater direct or reflected glare.

(4) When FR lamps are mounted behind and "aimed" at louvers or diffusers, their directional nature tends to give somewhat less uniformity of brightness between rows of lamps than would be obtained with regular F lamps.

The lower light output of FR lamps means that the total of the increases in luminaire efficiency, utilization factor and maintenance obtainable by using them in place of regular F lamps must be about 15 per cent before the illumination results with FR lamps will equal those with F lamps. Beyond 15 per cent, FR lamps show advantages.

A series of photometric tests on 40-watt luminaires enabled determination of comparative utilization factor and maintenance factor data for FR *vs.* F lamps in several representative commercial and industrial luminaire types. The tests were made both with clean luminaires and lamps and with simulated conditions of dirt accumulation on luminaires and lamps (see Fig. 1). These data were used to determine the comparative maintained illumination levels and costs of light given in Tables V and VI of the paper for FR *vs.* F lamps under typical dirt conditions of varying severity. The tables show the effect of various cleaning schedules for lamps and luminaires on the relative economic value of FR *vs.* F lamps. They also suggest the optimum choice of lamp type and cleaning schedule, depending on cleaning cost, lamp cost, power rate, burning hours per year, type of luminaire and severity of dirt conditions.

Based on the results presented, the relative lighting and economic value of FR *vs.* F lamps in typical general lighting applications using direct or direct-indirect luminaires might be generalized thus:

UNDER LIGHT TO MODERATELY HEAVY DIRT CONDITIONS ("average dirt conditions")

(1) With no cleaning of lamps or luminaires, FR lamps provide slightly higher maintained illumination at very slightly lower cost of light than F lamps.

(2) If lamps and luminaires are cleaned regularly on an appropriate schedule, both lamp types give significantly higher illumination. Regular F lamps provide about the same or slightly higher illumination than FR lamps at slightly lower cost of light.

(3) *Regular cleaning* on an appropriate schedule and the use of *regular F lamps* will result in *highest maintained illumination* and *lowest cost of light.*

UNDER SEVERE DIRT CONDITIONS

(1) With no cleaning of lamps and luminaires,

FR lamps provide significantly higher maintained illumination and lower cost of light than F lamps.

(2) If lamps and luminaires are cleaned regularly on an appropriate schedule, both lamp types give significantly higher maintained illumination and lower cost of light. FR lamps provide higher illumination than F lamps at about the same or slightly lower cost of light.

(3) *Regular cleaning* on an appropriate schedule and the use of *FR lamps* will result in *highest maintained illumination* and *lowest cost of light.*

(Abstract of I.E.S. Conference Paper No. 3)

A New Simple Approach to Group Relamping of Fluorescent Lamps

E. W. Beggs

THE STATISTICAL data from laboratory life tests on current product fluorescent lamps show that revolutionary changes have taken place in the last few years. More uniform life is obtained as a result of improved manufacturing control, principally of the electron emission compound on the lamp electrodes. A new mortality curve (Fig. 2) which is more "square" in shape now applies and the old more gradual curves are obsolete.

AUTHOR: Lamp Division, Westinghouse Electric Corp., Bloomfield, N. J.

The new curve shows that fewer lamps burn out early in life. This permits group relamping well out in the life cycle with fewer outages between group relampings. The new curve also shows a steeper slope beyond the "knee." This characteristic of the product requires that group relamping be done before the period of high mortality is reached in order to prevent excessive outages in the lighting system. Actually, the shape of this part of the curve makes group relamping almost a necessity.

Besides changes in the mortality curve there have also been changes in lamp operation in the average installation. There are strong indications that fluorescent lamp users turn lamps on and off less frequently than in former years. Today the tendency is to leave the lamps burning all day. The less frequent starting of lamps now results in longer lamp life in service.

A combination of these three new factors has changed the way in which group relamping systems are planned and operated. It is now practical and

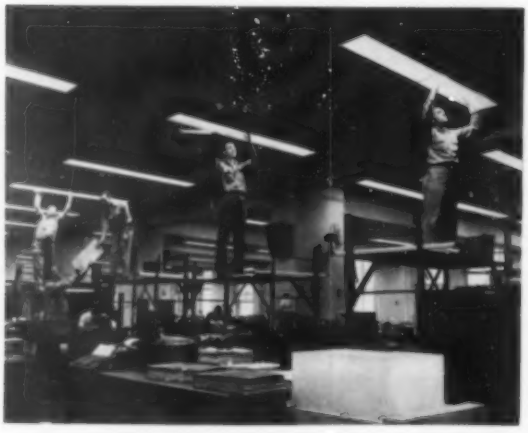


Figure 1. Efficient five-man team for group relamping with enclosed luminaire — cleaning every year — relamping every two years as they clean.

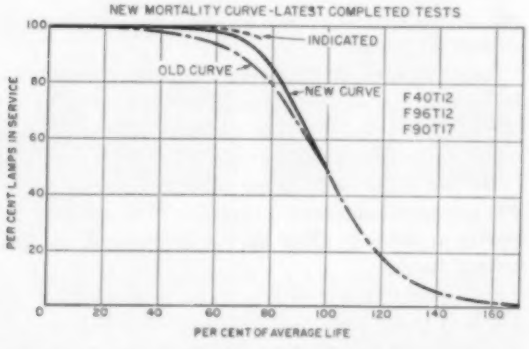


Figure 2. New mortality data on fluorescent lamps reveal improved uniformity in lamp life. Curve based on ideal laboratory operating conditions. This performance will be approximated in service with good lamps, equipment and line voltage within normal range.

economical to relamp on a calendar basis at a time when few if any of the lamps have burned out. This makes the group relamping system simpler and more satisfactory than heretofore.

Economic studies of representative installations show that minimum lamp plus labor cost for average single-shift operations will be obtained at two- to three-year group relamping periods if ideal laboratory operation conditions are involved. For normal average operating conditions, a two-year period (Fig. 3) is recommended and is quite widely used today. Similarly, for two- or three-shift operations, 18 months is the recommended and widely used interval between group relampings.

With the new simple system only a few lamps will burn out between group relampings. This reduces work interruptions and the cost of spot relamping to a minimum. Also, group relamping is carried out before the period of high lamp mortality is reached. This makes it possible to keep the system operating without a temporary increase in the relamping crew. In addition, all the lamps are removed before they get too dim.

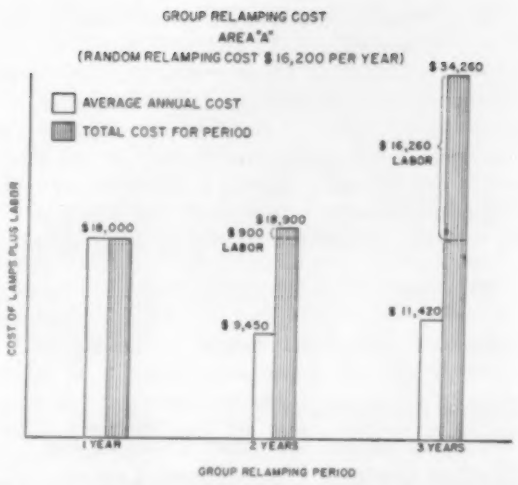


Figure 3. Two-year relamping scheduled at cleaning time is best for efficient office with enclosed luminaires. This provides low cost, top lighting maintenance and minimum work interruptions.

(Abstract of I.E.S. Conference Paper No. 4)

Light Directing vs. Diffusing Media In Luminous Ceiling Areas

H. A. Odle

R. L. Smith

PREVIOUS methods of measuring and calculating the output of luminous ceilings or ceiling panels and the resultant work surface illumination have assumed cosine or near cosine transmission and reflection characteristics for the transmitting media. Actually, different materials have transmission and reflection characteristics that vary considerably, both in quantity and distribution of light, especially as a function of angle of incidence of the light striking them. Such variations produce not only a difference in cavity efficiency but also a difference in the way the cavity output is utilized in the room. Thus, although two different transmitting media may appear to have about the same transmission and reflection factors, when used as a ceiling cavity enclosure they may produce decidedly different illumination results.

An analysis of the design of prismatic light directing panels indicates that in a lighting installation the prismatic panels should give more light on the work plane than diffuse panels. This is due primarily to two factors: (1) the material from which prismatic panels are made is transparent and therefore should have a higher total output than the diffusers. (2) Since the prismatic enclosure contains the light within definite angular limits, it is reasonable to expect that less light will strike the room walls and more light will strike the work plane directly.

Since it appears unlikely that theoretical formulae to allow for such variable factors will be developed, a test installation was set up to deter-

AUTHORS: Holophane Co., Newark, Ohio.

mine coefficients of utilization under varying conditions of enclosing media and room ratios. Results of this investigation indicate that for very large rooms the light controlling medium shows an increase in utilization of about 12 per cent over the particular diffusing medium chosen, and for small rooms this difference goes up to about 25 per cent.

The investigation also showed that it is possible to consider a luminous ceiling as made up of a number of large luminaires having the same construction as the ceiling cavity. The size of the section of luminous ceiling chosen was 4 feet square. A standard photometric candlepower test on one of these typical sections of the particular ceiling involved can be used with the Zonal Interflectance Method to obtain coefficients of utilization for the entire ceiling.

(Abstract of I.E.S. Conference Paper No. 40)

Outdoor Applications of
New Reflector Contour Designs for Higher Output Fluorescent Lamps

S. C. Peek

J. P. Keenan

THE GENERAL lack of surrounding surfaces from which interflections can occur in outdoor lighting puts special emphasis on control in luminaire design. Furthermore, lighting engineers and the public as well are becoming more and more aware of the glare which is quite serious in many outdoor installations. This paper describes a few practical applications of a concept which is of value in the design of linear light source reflectors which maximize control and minimize glare. The recent introduction of higher brightness fluorescent lamps has given impetus to, and in some cases, made possible the applications described herein.

AUTHORS: Sylvania Electric Products, Inc., Salem, Mass.

Low Mounted Applications — Thirteen hundred feet of the touchdown area at Washington National Airport were illuminated by two continuous strips of reflectors using eight-foot high-output fluorescent lamps. The lamps were operated from a series

Figure 1. Nighttime photograph of parking lot installation using controlled fluorescent.

circuit which employed a ballast specially designed for this application. The reflectors resulted in very little glare as viewed from the cockpit. The same luminaire has been installed on 500 feet of the New Jersey Turnpike.

High Mounted Applications — Fig. 1 illustrates a parking lot illuminated by the 20-degree luminaire. The "20-degree" refers to the cut-off and is illustrative of the distance that can be illuminated for a particular mounting height. Each luminaire employs one eight-foot high-output lamp mounted at 25 feet. The fixture brightness is below 350 foot-lamberts when viewed from above the cut-off angle. The reflector design produces over one footcandle on a horizontal surface at 50 feet from the base of a luminaire mounted at 25 feet; all this from a single high-output lamp in a reflector only 9 inches wide. It is interesting to note that an 18-inch wide reflector would produce twice this amount, again with only one lamp. The candlepower distribution curve shows practically no light above 70 degrees. This is uncommon for fluorescent luminaire designs, and makes possible low mounting heights. This, of course, is of economic advantage and also results in more light on vertical surfaces.

Vertical Surface Floodlighting — There has been recent emphasis on floodlighting of vertical surfaces by means of fluorescent lamps. Vertical surfaces are easily seen at a distance and can be made to convey a sales message. With the use of the new technique it was possible to synthesize a reflector contour which gives remarkable uniformity. The vertical footcandle readings on a paint-board 20 feet x 50 feet, illuminated in this manner, averaged 27.3 footcandles with a minimum to average ratio of 1:1.3.

The advent of higher brightness fluorescent lamps of uniform cross-section and the development of a mathematical concept to handle reflector design have combined to make possible fluorescent luminaires of improved characteristics. Many outdoor uses for fluorescent lamps have been conceived but discarded because of the apparent lack of control possible with this light source. It is hoped that these can now be re-evaluated in the light of the concepts described herein.

(Abstract of I.E.S. Conference Paper No. 35)

Floodlighting Niagara Falls

W. A. Dalrymple

C. A. Albini

THE FALLS on the Niagara River, including Goat Island, cover a horizontal distance of approximately one mile and subtend an angle of 114½ degrees from the floodlighting rotunda on the Canadian side. Vertical heights of water vary between 162 and 167 feet.

In June 1955 when the Niagara Falls Illumination Board decided to investigate the renovation of their floodlighting system, one of the manufacturers contacted was in Great Britain. One year of research and experimentation was carried out there, and after an actual demonstration with a prototype, their scheme was selected and installed in June 1958.

Since the existing supply of 375 kw of d-c power was not to be exceeded, 20 units of 18¾ kw each were provided, as against 24 units of the old type, giving seven to ten times the brightness and covering about twice the area. The view one now sees (Fig. 1) takes in a complete panorama of the American and Bridal Veil Falls, the rock face of Goat Island, Upper Rapids, Canadian Falls and the vertical plume of spray from the latter.

Investigations were made of all known sources of light and color media for the color effects and of mechanical devices for automatic changing of colors. The equipment finally selected (Fig. 2) was to provide an efficient, economical and reliable scheme.

The searchlight used is a high intensity carbon arc rated at 150 amperes and 75 arc volts. The parabolic mirror is 90 cm in diameter with a 42-cm focal length. The lamp mechanism provides for a 22-inch long axially rotating positive carbon burning at 9¼ inches per hour, and a 14½-inch negative feeding at 1¾ inches per hour. Both are 16 mm

AUTHORS: Amalgamated Electric Corp., Toronto, Ont.

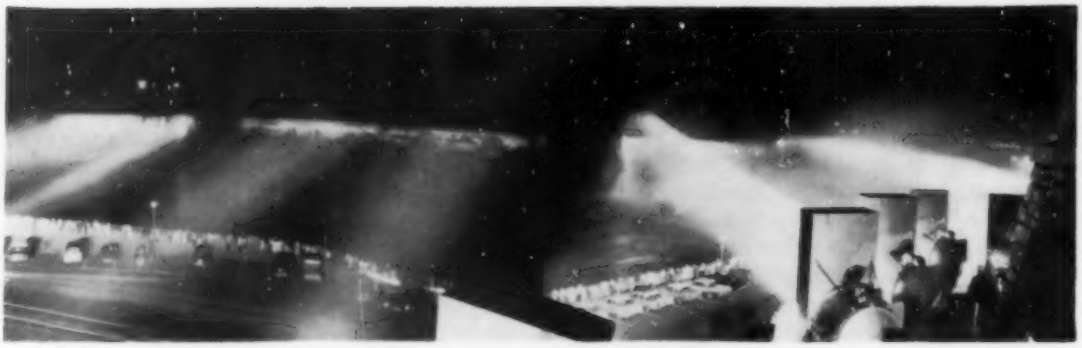


Figure 1. Complete panoramic view of the Falls with the new floodlighting system.

in diameter. The voltage across the arc controls the speed of the motor driving the carbons, thus maintaining the correct focal position of the arc. The searchlight housing, made of aluminum alloy, is cylindrical with access doors at each side.

Each unit has a control box which contains the motor drive and gear trains for feeding the carbons. A focuscope screen shows the arc image and the positions at which carbons should be maintained. A carbon warning indicator lamp glows some ten minutes before the positive carbon is due for changing. A six-inch diameter, one-quarter horsepower extractor fan disposes of the fumes from the barrel and provides cooling.

The color changer unit attached to the front of the searchlight is rectangular in shape, 7 feet 4 inches high, 4 feet wide and 2 feet deep. The upper half stores the color frames and the lower half coincides with the searchlight beam. Each 37-inch square color frame, activated by a small geared down motor, can be individually controlled to rise or fall by sliding in tracks. Travel is stopped at top and bottom by limit switches. Five carefully selected colors — amber, magenta, blue, pink and green when used singly, in pairs or in threes give a variation of 15 different colors.

Each of the 100 color frames is connected electrically to a master control panel remote from the floodlights. The panel has 20 banks of five two-way and off switches which are pressed up or down to move the color frames. The center position is off. A master switch allows a selection of colors to be pre-set and when the switch is depressed these colors are brought into motion. The same master switch when pressed upward lifts all the colors so that white light can be projected. Various color frames can travel up or down at the same time, with the result that a continuously changing blend of color is possible.

The twenty searchlights on the rotunda (Fig. 3) provide for complete panoramic lighting from the extreme left of the American Falls to the extreme right of the Canadian (Horseshoe) Falls.

(Abstract of I.E.S. Conference Paper No. 1)

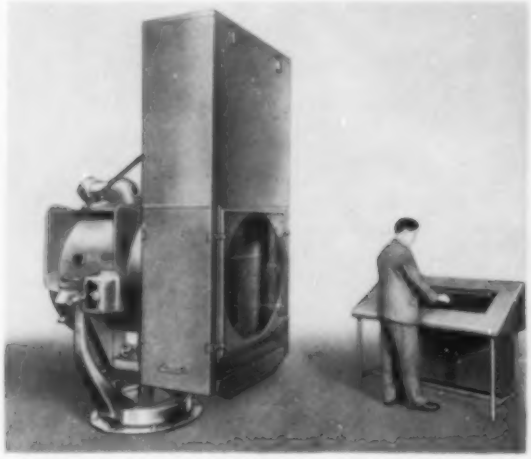


Figure 2. Searchlight complete with color changer and remote control console.

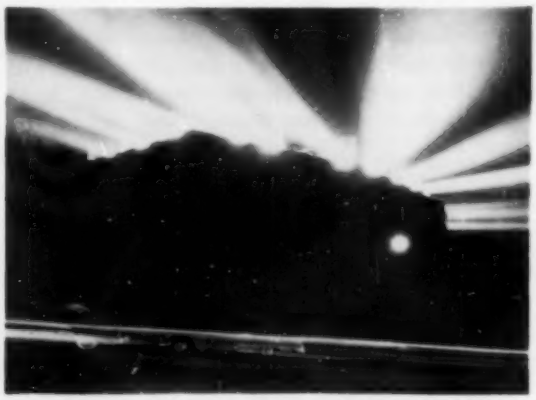


Figure 3. View of rotunda showing location of searchlights.

Some Possibilities for
Enrichment of Luminous Ceilings

Gyorgy Kepes

Robert O. Preusser

Domina E. Spencer

Leonard F. Martin

During the last decade, luminous ceilings have grown from an idea which was widely regarded as totally impractical to a well-established method of producing a desirable luminous environment. Today's luminous ceilings are simple in design; they make no attempt to exploit the inherent possibilities of transmitting light through textured and patterned details in the diffusing plastic. Perhaps one of the chief reasons why luminous ceilings have been limited in their use is that architects may fail to realize the potential of designing constructively with this transmitted light through use of texture, pattern and color. The objective of this paper is to point out some of the possibilities of enrichment of luminous ceilings through use of the above procedures with a supporting structure which imposes no limitations on the design. Three types of criteria are considered.

Architectural Criteria. Luminous ceilings can be molded as a sculptor molds his clay. With a little thought, the light source, the forms in space and the textures and colors of these forms could very easily be integrated into the architectural whole. The forms of solid objects can be emphasized by use of textural gradients (Figs. 1 and 2) and contrasting textures. Although these details are able to make the space pattern legible, they should also be subservient to the primary architectural forms. Luminous ceilings should be free of strong pattern, yet there should be a delicate, subdued pattern which provides texture and value gradients and gives the architect freedom to express the individuality of a room.

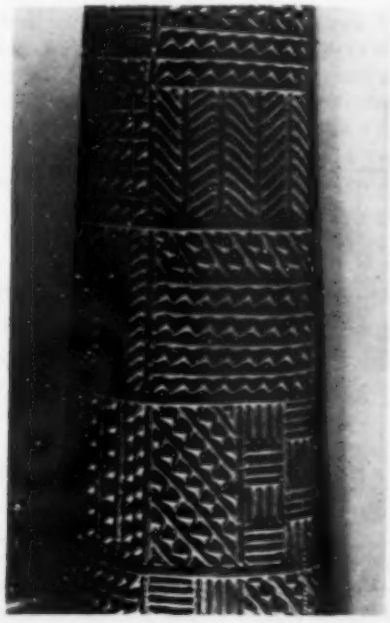


Figure 1. Texture in native carving, Pacific Islands, Peabody Museum, Cambridge, Mass. Photograph: Kepes.

Visual Criteria. Luminous ceilings should continue to provide excellent visual conditions for all people in the room no matter what they are doing or where they are located. This means that there are limitations on the way in which color and patterned detail can be introduced into luminous ceilings. High contrast and saturated colors are permissible if confined to very small areas, but large areas must be limited to low contrast and low chroma. There are advantages in designing the luminous panels so that maximum transmittance is in the vertical direction, provided that this maximum transmittance is still sufficiently low so that there is a minimum of reflected glare.

Structural Criteria. The suspension system should

Authors: Drs. Kepes and Preusser, Professor and Assistant Professor of Visual Design, Department of Architecture, Massachusetts Institute of Technology, Cambridge, Mass.; Dr. Spencer, Associate Professor, University of Connecticut, Storrs, Conn.; Mr. Martin, President, Marlux Corp., Billerica, Mass.

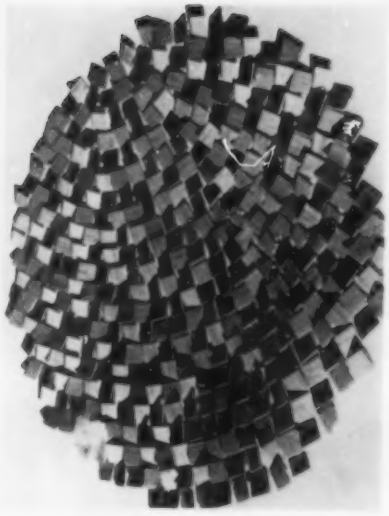


Figure 2. Design for textured acoustic ceiling, by Dorothy Pelzer, student of Professor Kepes.

be so designed that the ceiling becomes a blank canvas on which the architect can create any three-dimensional texture, value and color with maximum freedom. By eliminating the restrictions imposed by a visible supporting system, an important step has been made toward greater design possibilities.

Modular plastic panels of a variety of designs should fit into the same supporting structure. Such panels can be designed to make up a pleasing pattern either by controlled or random orientation within the invisible supporting structure. Combinations of several different coordinated patterns in a single ceiling place further variations at the architect's disposal. The panels should be small enough to be readily adaptable to a variety of design modules. Throw-away panels of thin plastic appear to be the best solution to the costly maintenance problem, thus combining the economics of group replacement of lamps with group replacement of panels.

(Abstract of I.E.S. Conference Paper No. 39)

Morgan Christensen

Quentin D. Dobras

Mercury and Fluorescent Team-Up for Industry

A COMBINATION of mercury and fluorescent lamps in a lighting system offers several advantages. Fluorescent lamps, like filament lamps, provide stand-by protection in the event of a power interruption and improve color quality. Moreover, both fluorescent and mercury lamps can operate efficiently at the higher distribution voltages which are becoming more common in industry. In addition they have similar efficiencies and lamp lives, resulting in minimum operating costs and simplified lighting maintenance. The new higher wattage fluorescent lamps are also comparable with mercury lamps in light output.

Studies show that the initial cost of a mercury and fluorescent combination is higher than the mercury and filament system; however, the non-circular cross section fluorescent lamps have permitted a significant reduction in initial cost over the older types of fluorescent lamps. The operating costs for the mercury and fluorescent combinations

AUTHORS: Large Lamp Dept., General Electric Co., Cleveland, Ohio.

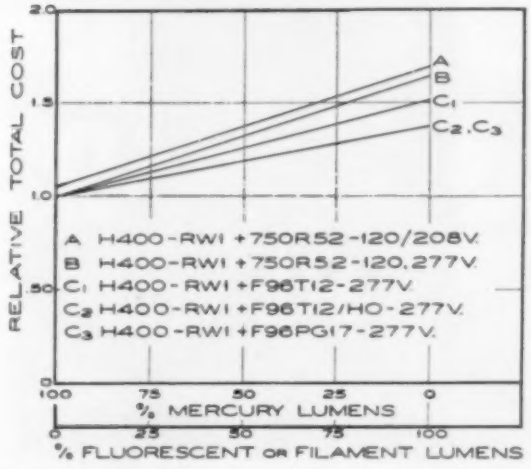


Figure 1. Relative total annual costs for mercury combination system.

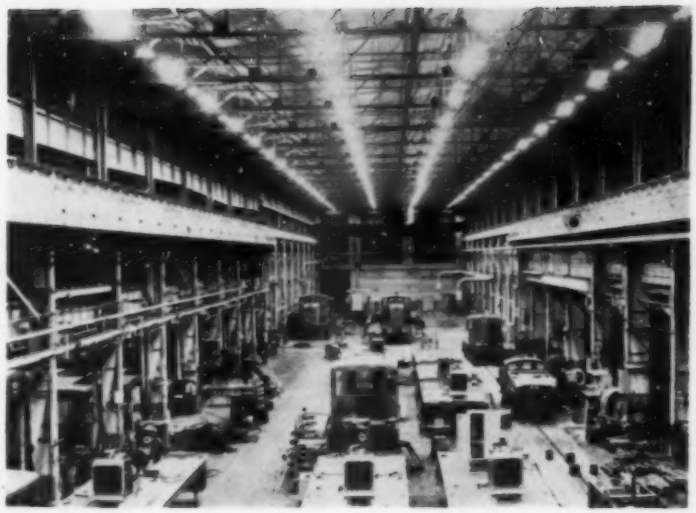


Figure 2. The 100-watt filament units in this area have been replaced by 2-lamp (96PG17) non-circular cross section fluorescent luminaires. The fluorescent lamps plus the mercury lamps (H400-RC1) provide 70 footcandles. Changing from filament to fluorescent in this area increased the illumination level and decreased the amount of energy used.

are considerably lower than the mercury and filament systems, as would be expected.

The relative total annual costs in Fig. 1 show that the most economical combination system is mercury lamps combined with either the high-output (96T12) or non-circular cross-section (96PG-17) fluorescent lamps. Stating this another way, a typical total annual cost for a mercury and filament system in which nearly equal lumens are provided by each lamp type is approximately 1.7 cents per footcandle per hour for 10,000 square feet of lighting. The same cost for a similar mercury and fluorescent system is 1.4 cents — a reduction of 18 per cent in the total annual lighting costs.

Several plant owners have already recognized the advantages of combination mercury and fluorescent lighting and have installed such combinations in various types of areas. In some systems the fluorescent lamps provide only enough light for minimum safety purposes. In other installations fluorescent systems have been added to an existing mercury system to increase the lighting level and provide upward light. In some of these systems, most of the light is provided by the fluorescent lamps. Fig. 2 shows one of the newest combination fluorescent systems. In this installation, filament lamps were replaced with lamps with non-circular cross section to increase the lighting level and decrease the energy consumption. The plant engineer reports that the savings will pay for the fluorescent installation in three years.

The advantages of a combination mercury and fluorescent system are numerous. In general, such systems consume less power, are easier to maintain and less costly to operate. New developments in mercury and fluorescent lamps and equipments should prove even more advantageous to this combination in the future.

(Abstract of I.E.S. Conference Paper No. 37)

Evaluation of Performance of

Polystyrene Components of Fluorescent Luminaires In Actual Service and Under Accelerated Testing

By D. A. Popielski* and R. A. McCarthy (right)

*No photograph available.

AUTHORS: Monsanto Chemical Co., Plastics Division, Springfield, Mass.

THE RATE of discoloration of polystyrene fluorescent luminaires in actual field use has not previously been fully defined. Many installations have given service for five years or longer without objectionable yellowing, but instances of shorter acceptable service life have been significant.

To allow prediction of the maximum useful life obtainable from a general purpose polystyrene luminaire, data are presented which correlate the

rate of discoloration with lamp selection at various lamp-to-plastic distances. The data are summarized in Fig. 1, and while they pertain specifically to general purpose polystyrene, they are also applicable to light stabilized grades of polystyrene on a relative basis.

From time to time various accelerated aging test methods for accurate prediction of long term end-use performance of plastics have been advocated. The testing of one specific material to exposure under any ultraviolet source can be empirically correlated with application performance. However, when two or more dissimilar materials or the same resin with different stabilized systems are tested under the various aging units, poor correlation and/or direct reversals are obtained in comparison to actual usage.

The absolute correlation of these test methods to actual fluorescent lighting and outdoor exposure was studied using various stabilized polystyrene systems. An analysis of the results obtained is described and these results correlate well with the divergency of the emission spectrum of the accelerated aging units to that of fluorescent lighting and solar energy. A comparison of the relative spectrum distribution of the test methods studied is shown in Figs. 2a-d.

(Abstract of I.E.S. Conference Paper No. 2)

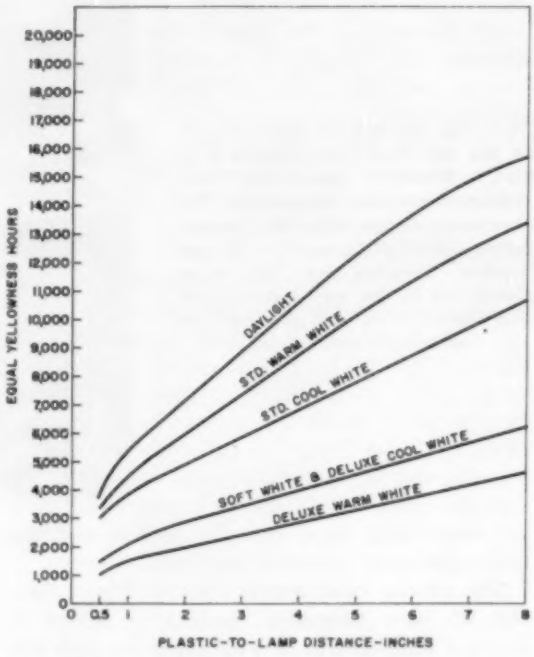


Figure 1. Equal yellowness hours of continuous exposure at various plastic-to-lamp distances for six common 40-watt T12 fluorescent lamps.

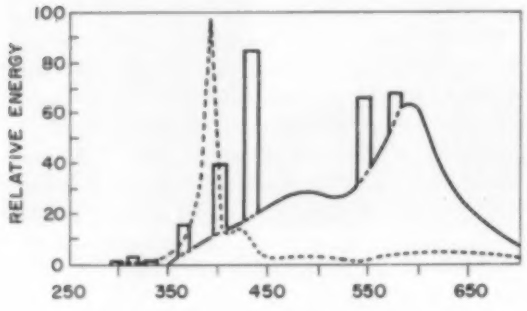


Figure 2a. Atlas Fadeometer.

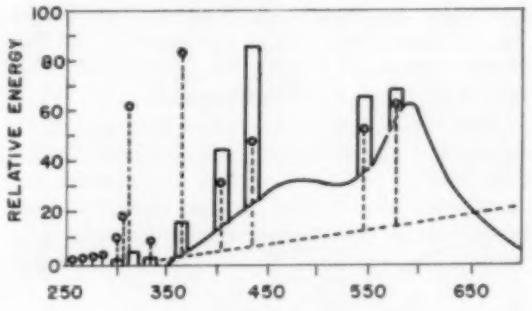


Figure 2b. S-1 Sunlamp.

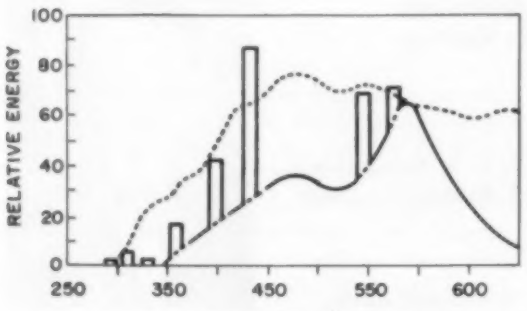


Figure 2c. Solar energy.

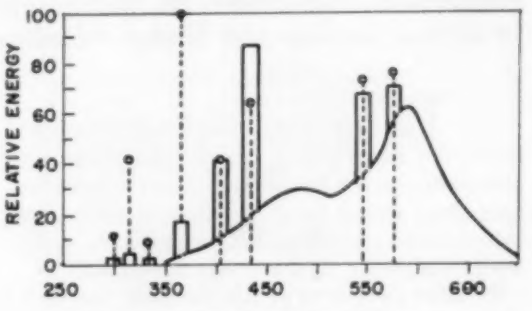


Figure 2d. UViarc.

Maintenance Factors and Features of

Industrial Fluorescent Luminaires

George J. Taylor

R. D. Bradley

MAINTENANCE of lighting systems is a subject which, like death and taxes, seems to be with us always. Various theories, studies and proposals have been discussed many times in the past, from the floor and in print. Behind all this discussion, however, has been the need for factual information on what actually happens in service. Comprehensive maintenance studies become rather involved when they try to simulate actual conditions found in factory production areas. Working factories are usually unable to provide space for prolonged testing and such tests must be prolonged if the results are to be of any value. Reliable and realistic data depend on such conditions.

Reliable maintenance data are of particular importance to industry these days, all the more so with the current demand for higher levels of illumination. Poorly maintained lighting systems depreciate in light output — ergo, reduce production output.

Lack of available information in actual practice has led to many hazy estimates, if not guesses, in applying *maintenance factors* (MF) for luminaires in industrial areas. This is especially true of the new types of fluorescent luminaires currently used for factory lighting. The prime purpose of this in-service study was to provide at least a start in securing maintenance data for present-day industrial lighting systems.

Although there are many varieties and combinations of reflector styles and fluorescent lamps used in production areas, in general they fall into three categories. Broadly speaking, the three classifications are:

(1) Solid top reflectors with all light directed downward,

(2) Slotted top reflectors with approximately 10 per cent uplight,

(3) Slotted top reflectors with approximately 30 per cent uplight.

The significant data accumulated over approximately two and one-half years are plotted in Fig. 1. The upper set of curves represents the rate of depreciation of dust and dirt accumulation on lamps and reflectors and the normal depreciation of the lamps. The lower set of curves shows the rate of depreciation due only to the dust and dirt accumulation on lamps and reflectors. The lamp depreciation curve is taken from recent information provided by lamp manufacturers.

The results plotted in Fig. 1 disclose information of value in the study of maintenance of industrial luminaires. To cite one specific example, the dust and dirt accumulation is tabulated below for test units after approximately 30 months service.

Relation Depreciation Due to Dust and Dirt

	In Per Cent of Solid Top Reflectors
Solid Top Reflectors	100
Slotted Top Reflectors (10% uplight)	87.5
Slotted Top Reflectors (30% uplight)	56.0

The authors wish to strongly emphasize the fact that the tests reported are not to be construed as an answer to all lighting maintenance problems.

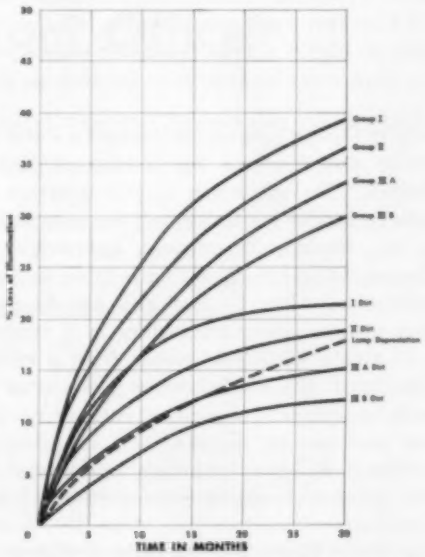


Figure 1. Depreciation curves as plotted from test data.

AUTHORS: Day-Brite Lighting, Inc., New York, N. Y. and St. Louis, Mo., respectively.

The tests are for one set of conditions only and afford valuable information in this behalf. Previous experimenters have made available data that can be used with the data presented in this paper. For instance, tests conducted by others in the past, on fluorescent luminaires with closed top reflectors might well be used in determining results with slotted top reflectors by means of mathematical proportions from data given in this paper.

(Abstract of I.E.S. Conference Paper No. 36)

Left to right:
W. H. Johnson
J. L. Winpisinger
J. F. Roesel, Jr.

Design and Application of

A New High Frequency Power Source For Fluorescent Lighting

WITH THE advent of higher wattage fluorescent lamps, ballasting equipment has increased in size, weight and power loss. It has been known for some time that a method for reducing luminaire weight, maintaining units at a minimum practical size, and keeping heat dissipation from becoming a problem is to operate fluorescent lamps from a high frequency power source. The problem has been to obtain a high frequency source which has the necessary characteristics for such an application.

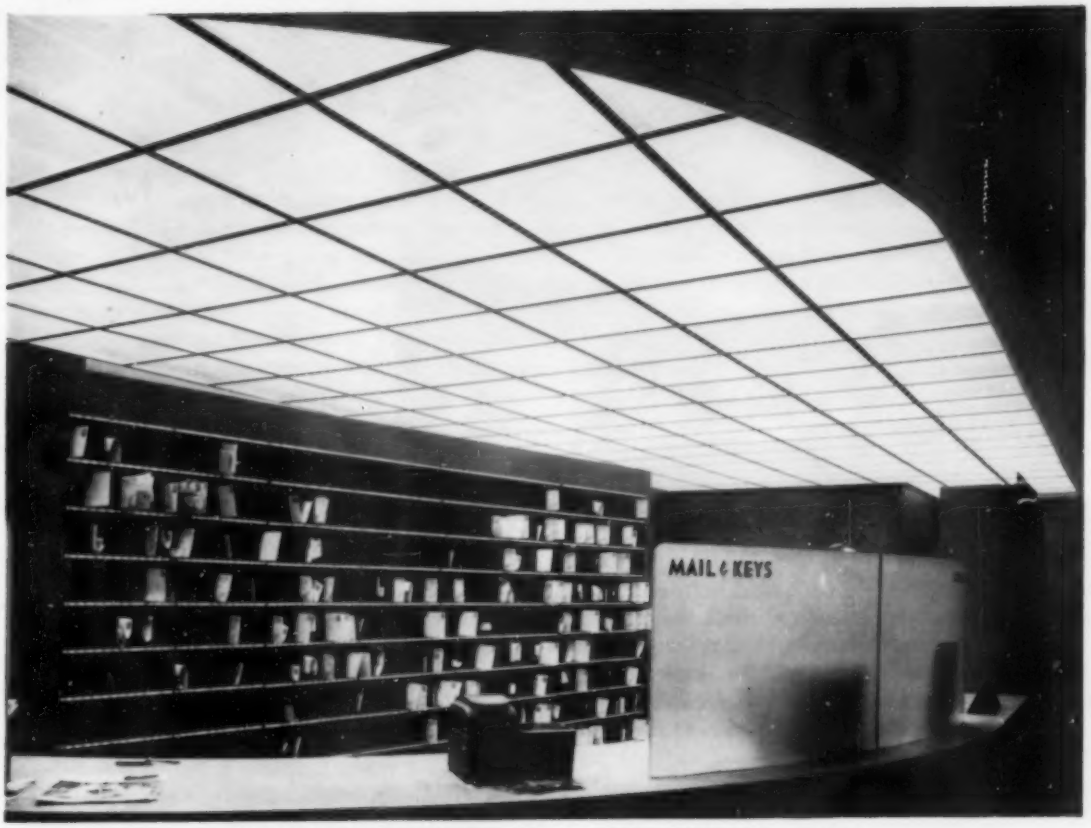
Early in 1956, a program to develop a static high frequency power source for fluorescent lighting was begun. The outgrowth of this program is a frequency changer for fluorescent lighting which is completely static, very efficient, lightweight and small enough in electrical rating to allow flexibility of installation. (Fig. 1) Basically, this frequency changer utilizes power transistors in a switching mode to obtain 1500-cycle power from a rectified 60-cycle input. Since this frequency converter uses all static components, it requires little or no maintenance and has an expected life comparable to conventional 60-cycle ballasting equipment. The present converter occupies approximately .3 cubic foot and weighs 11 pounds. It is designed to operate 1500 watts of fluorescent lamp load at 1500 cycles. The efficiency at full load is approximately 94 per cent.

The rapid development of new and better semiconductor devices indicates a promising future for converters of this type.

(Abstract of I.E.S. Conference Paper No. 5)

Figure 1. 1½-kw transistorized high frequency converter shown at top of picture. Standard 60-cycle ballast cans in black compared to 1500-cycle ballast size in light color. From left to right: 2-lamp, 8-foot, 1500-ma ballast; 2-lamp, 8-foot, 800-ma ballast; 2-lamp, 4-foot, 430-ma ballast.

AUTHORS: Messrs. Johnson and Winpisinger, Westinghouse Electric Corp., Lighting Division, Cleveland, Ohio; Mr. Roesel, Westinghouse Electric Corp., New Products Engineering, Chesnick, Pa.



INSTALLATION AT HOTEL CLEVELAND, CLEVELAND, OHIO.

Lighting a Hotel Front Office

LIGHTING OBJECTIVE: To provide a high level of comfortable general illumination for the reservation desk and cashiers' area of a large hotel.

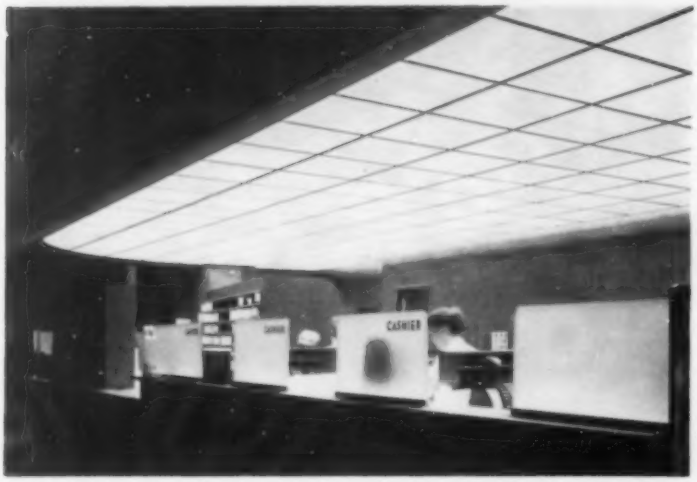
GENERAL INFORMATION: This completely remodeled lobby desk measures 44 feet x 15 feet, with a height of 10 feet from the floor to the existing ceiling. A plaster curtain wall was dropped to provide a plenum of 14 inches for the over-all area illumination. A wood grain plastic covering is used over the walls. New flooring was installed. Reflectances are as follows:

ceiling	plenum above diffusers	75% RF
walls	brown plastic	9% RF
floors	vinyl tile	15% RF

INSTALLATION: An inverted tee bar suspension system is installed in 24-inch x 24-inch modular design. The suspension equipment is rigidly fastened to the curtain wall and the side walls, but hangs free as a floating panel along the back wall. The 24-inch square diffuser panels are Holophane "Prismalume" Controlens No. 6024, a plastic prismatic lens designed to bend the light away from the eyes of a viewer glancing up, yet to direct the light down upon the desk top and work areas.

(over)

A.I.A. File No. 31-f



View showing cashiers area.

Continuous rows of single lamp fluorescent channels (Pittsburgh No. A-180RS) with 40-watt deluxe warm white rapid start lamps are mounted on 24-inch centers directly on the ceiling, approximately 10 inches above the center of each lens.

An average of 70 footcandles is maintained over the critical work area. Brightnesses are as follows:

Luminaire (plastic)	
at 45 degrees	41 fL (Maximum)
at 60 degrees	35 fL (Maximum)
Walls	2.4 fL
Work task, printed material	33 fL
Floor	8 fL

Lighting designed by Frank Foster, Director of Hotelco Studios, Design Division, for Hotel Corporation of America; over-all area illumination designed by Lewis S. Sternberg, Pittsburgh Reflector Co., Cleveland, Ohio and Norman Falk, Holophane Co., Cleveland, Ohio; electrical contractor: Parker Electric Co., Cleveland, Ohio.

Lighting data submitted by Lewis S. Sternberg and Norman Falk as an illustration of good lighting practice and to aid in the design of similar installations.

Published by the Committee on Publications of the Illuminating Engineering Society, 1860 Broadway, New York 23, N. Y.

Fluorescent Ballast Protection

By GEORGE E. PIEPER

MANY CHANGES have taken place in the fluorescent lighting industry during the last five years. If asked to list some of these changes, most people would probably name: New higher output lamps, new fixtures, a trend toward luminous ceilings, and new shallow types of fixture made for ceiling mounting. How many would even mention that ballasts have also been changed considerably during this period? With the trend for shallower fixtures, ballasts have been designed with a considerably smaller cross-sectional area.

A ballast is a device that, by its very nature, runs at elevated temperatures. It is natural to expect that a change toward smaller cross-section design, without reducing the output, results in increased temperatures in the ballast. Today ballast coil temperatures run from 90C to 100C in normal operation. All ballasts are made with Class "A" insulation which has a temperature limit of 105C.

When a ballast is running under normal conditions, this small margin (15C maximum) is sufficient to assure normal ballast life expectancy of approximately 12 years. But under some conditions temperatures may exceed 105C by a substantial percentage. If fluorescent ballasts are left to run at these elevated temperatures, the life of the insulation deteriorates rapidly.

It has been found that a ballast running at 115C will have an average life of only six years, and a ballast running at 125C will have an average life of only three years. These temperatures may be compared with some that may be experienced under fault conditions.

With one lamp out, some ballasts run as high as 125C. This fault is not always taken care of immediately. With group replacement, for example, relamping is done on a schedule of perhaps three times a year, rather than on the basis of replacing burned-out lamps as soon as they fail. This could result in the ballast being overheated for several months. Such practice may not cause the ballast to fail when it happens the first time. But if it is left unattended each time end of lamp life occurs, the ballast will obviously need replacement long before the end of its normal life.

Another condition that causes overheating is lamp rectification. Some fluorescent lamps begin rectification near the end of life and during this rectification the coil temperature may reach 180C or more. With individual lamps which have a short life, this rectification may well occur in a few thousand hours instead of at the end of normal lamp life. While rectification may not last more than a week or two at the most, the excessive tem-

AUTHOR: Spencer Thermostat Div., Metals & Controls Corp., Attleboro, Mass.

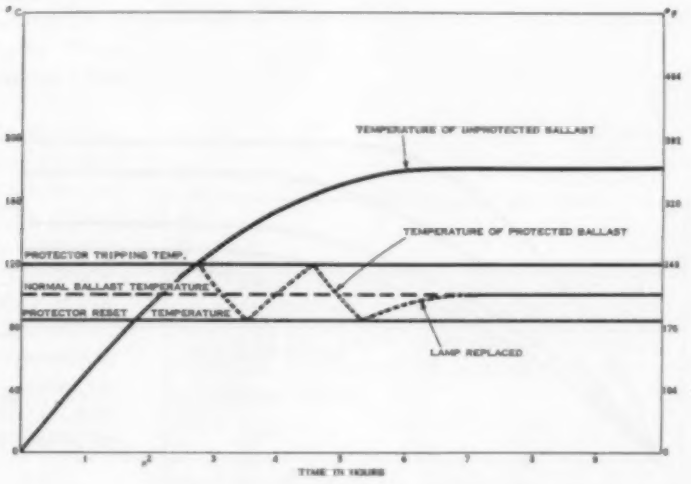


Figure 1. Characteristic curve of ballast temperature — secondary coil — one lamp rectifying.

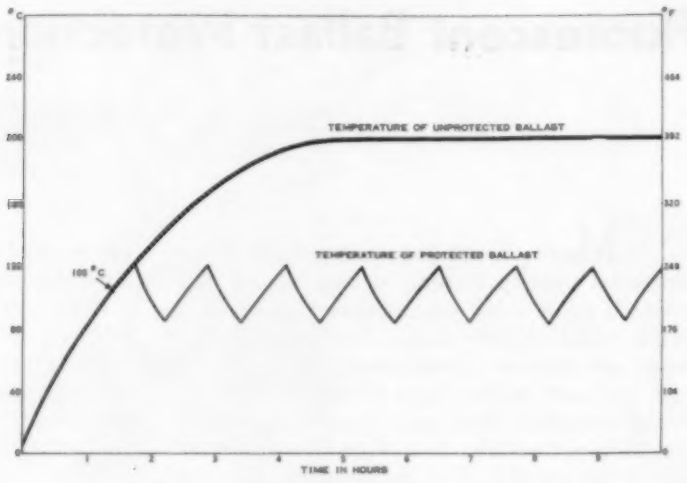


Figure 2. Characteristic curve of ballast failure — internal short, usually at end of normal ballast life.

peratures experienced in the coil of the ballast can melt the pitch, causing it to drip and, at the same time, causing rapid deterioration of the insulation. To prevent these excessive temperatures in a ballast, a "protector" can be built into the ballast which will automatically disconnect the ballast whenever its temperature passes the reasonable limit. After cooling, the ballast automatically resumes operation.

Fig. 1 shows the condition of rectifying lamp. By having the "protector" reset temperature below 85 C, the average temperature of the ballast will be slightly above 105 C and, therefore, will not shorten the insulation life. The protector in the ballast will control the operation of the ballast for safe temperature limits and maximum light output. After the lamp has been replaced, the fixture will operate normally with no expectation of a shorter life for the ballast.

The same results will be experienced when a lamp has failed and is left in a deactivated condition for many months. In these circumstances also, life will not be shortened if the ballast is automatically disconnected when overheating occurs.

Two other conditions often give trouble. These are: first, a fixture which is not properly dissipating the heat and, second, cases where some error has been made in the installation of the fixture, causing it to overheat. In both of these conditions, temperatures up to 150C have been experienced, and ballast failure has resulted. With "protected" ballasts, these conditions would be brought to the attention of the engineer while the contractor was still on the job. Measures could be taken to cor-

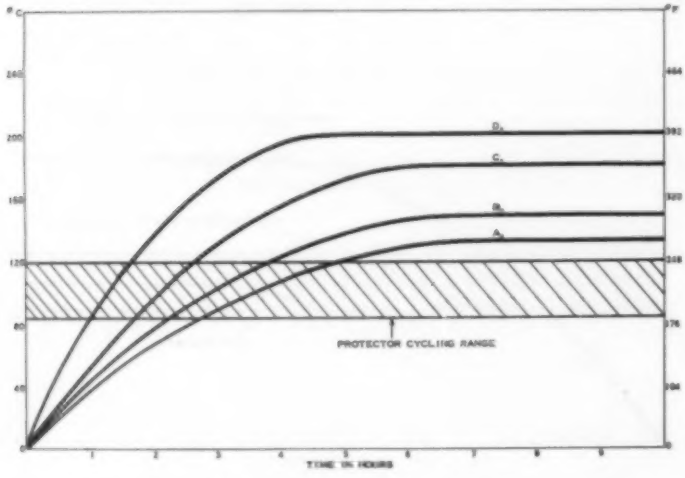


Figure 3. Characteristic curves:
A — one lamp out, some ballasts,
B — poor heat dissipation,
C — lamp rectification,
D — ballast failure, usually end of normal life.

TABLE I — Per Cent Insulation Limit Is Exceeded Under Four Fault Conditions. 105C = 100%.

Fault	Per Cent of Insulation Limit
One lamp out	130
Rectifying lamp	170
Poor heat dissipation	145
Internal short	190

rect the fault condition before equipment is moved in under the fixtures, thus eliminating the danger of pitch dripping on equipment and personnel.

When a ballast reaches end of life, it fails because of deterioration of the insulation. At this time internal shorts or hot spots may occur, which may push temperature as high as 200C or more. Dripping pitch, ignition of adjacent combustible material or even violent failure may be the result.

Fig. 2 shows temperature characteristics under the condition of internal shorting. With a protected ballast, these high temperatures will not develop. However, the ballast must be replaced. The protector will have served its purpose in eliminating the hazards encountered at the end of the life of the ballast.

Five conditions have been cited which may cause overtemperature in a ballast. Fig. 3 shows all of these conditions. (Line "B" represents both poor heat dissipation and installing error.) It is evident that under conditions, "A," "B" and "C," a protected ballast can be used for the rest of its normal life when the fault condition has been corrected. It is similarly evident that the occurrence of these faults in unprotected ballasts can readily lead to insulation deterioration.

Wiring devices are usually built to withstand 115 to 125 per cent overload for short periods of time. Table I shows that unprotected ballasts under the conditions noted will experience from 130 to 190 per cent or more overloads, and sometimes these conditions last for many months. These overloads are clearly too much to expect from Class "A" insulation.

Protected ballasts have been tested by enclosing the ballast in an insulated box to force elevated temperatures. The ballasts run 24 hours a day for 365 consecutive days. During the test the ballast protectors shut off when the protector limit was reached and upon cooling, relighted the lamps. This cycle occurred 5000 times. The test is equivalent to five years of operation on a fault condition in the average office on the basis of 10 operating hours per day. At the end of the 5000 cycles the ballast was still in operating condition and able to continue in normal operation for the rest of its normal life.

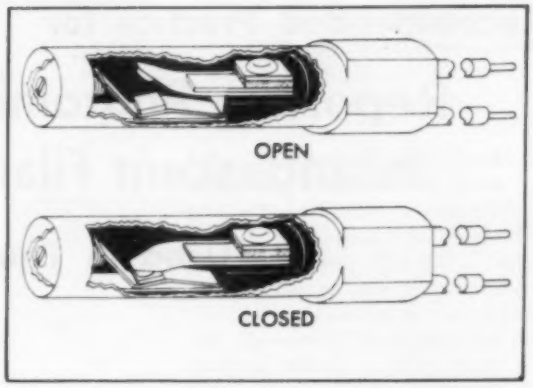


Figure 4. Cutaway diagram of ballast protector.

A ballast employing a protector device will operate slowly under fault conditions; *i.e.*, when the protector turns the ballast off, due to the mass of the ballast and the fact that the rate of temperature rise was slow, it will stay off for 20 to 30 minutes before resetting. This eliminates flicker. In other words, a protected ballast will assure maximum output of light until the ballast reaches a temperature where continued usage would cause reduction in insulation life. It then turns the ballast off and allows the ballast to cool down until it is safe for it to continue operation. It will allow the ballast to operate until the fault condition pushes temperature up to the unsafe limit again. Upon correction of the fault, the ballast which has thus not been abused, should carry on to normal full life.

Currently, such protector device is built into the ballast adjacent to the coils and in series with the primary winding. Any fault will cause complete electrical disconnection from the line. Both 118-volt and 277-volt ballasts have been built with protectors and have been approved by Underwriters' Laboratories.

Changes in mailing address should be reported to IES Headquarters Office by the first of any month to ensure the uninterrupted mailing of IE and other Society communications.

Recommended Practice for

Reporting Photometric Performance of Incandescent Filament Lighting Units

Used in Theatre and Television Production

Prepared by the Joint I.E.S.-S.M.P.T.E. Committee on Equipment Performance Ratings

Foreword

The Recommended Practice presented herewith represents three years work by the participating committees. Of necessity it resulted in the formation of an inter-society committee, the Joint I.E.S.-S.M.P.T.E.* Committee on Equipment Performance Ratings.

The original charge to the Joint Committee was to establish a uniform method of reporting the photometric performance of lighting units used in theatre, television and motion picture production. As the work progressed the Joint Committee requested a more limited scope of study; accordingly the present report is limited to incandescent filament lighting units used in theatre and television production. It is hoped, nevertheless, that a basis has been established for further study on units requiring other than incandescent filament sources, and on units used in the motion picture industry where they differ from those reported herein.

For purposes of actual test procedure the Joint Committee has depended upon the various I.E.S. guides on photometry and photometric testing listed in Section 4. For the materials on incandescent filament sources presented in Appendix A,** the Joint Committee is heavily indebted to the Light Sources Committee of the I.E.S.

The Recommended Practice has been subjected to close review and criticism by many leading photometric testing engineers as well as lighting designers, engineers and operating personnel in the theatre and television production fields. No effort has been spared to make this Practice authentic and practical. Every effort has been put forward to encourage uniformity in reporting sound engineering data on the lighting units described herein.

As with other guides or recommended practices, it is of course true that this Practice is of value only to the extent it is accepted and used by the lighting profession and the lighting industry. The Joint Committee recommends the following procedures and expresses the hope that they will find immediate acceptance by the members of I.E.S., S.M.P.T.E., and the lighting industry.

Joint I.E.S.-S.M.P.T.E. Committee on Equipment Performance Ratings

Joel E. Rubin, *Chairman*

Subcommittee on Lighting Equipment Performance Ratings of the Committee on Theatre and Television Lighting of I.E.S.

Alfred W. Boylen — Walter O'Meara
Stanley McCandless — Kenneth Palius
Rollo Gillespie Williams

Subcommittee on Equipment Performance Ratings of the Television Studio Lighting Committee of S.M.P.T.E.

Frank E. Carlson — H. M. Gurin
George T. Howard — Robert M. Morris

Approved by the Council of the Illuminating Engineering Society, October 1957. A Transaction of the Society.

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I.E.S.-S.M.P.T.E. Inter-Society Representative

Herbert A. Kliegl

1. Objectives

(a) This recommended practice is designed to establish a uniform method of reporting the photometric performance of incandescent filament lighting units used in theatre and television production.

(b) This recommended practice specifies the particular data which shall be included, as a minimum requirement, for a photometric report of such units.

(c) An effort is made to standardize

*Illuminating Engineering Society–Society of Motion Picture and Television Engineers.

**Not published here. Data from third edition of *IES Lighting Handbook*.

TABLE I — Schedule of Lamp Life Hours and Filament Forms for Reporting Data as per Section 3(b).

Type of Equipment	Wattage	Rated Life in Hours	Filament Form*
Fresnel-lens spotlights	up to and including 2000	200	C-13
	5000	150	C-13
	10,000	75	C-13
Ellipsoidal-reflector spotlights	up to and including 2000	200	C-13D
	3000-5000	100	C-13D
Plano-convex-lens spotlights	up to and including 2000	200	C-5
Follow spotlights	all	rated life of lamp used	—
Scoops, Floodlights and Striplights employing 750-1000 hour lamps	up to and including 60	1000	—
	75-300 (Medium Base)	750	—
	300-2000 (Mogul Base)	1000	—
Parabolic-reflector projectors	up to and including 750	200	C-13
	1000-2000	200	C-5
PAR and R lamps in housings	all	2000 (except for special lamps)	—
Scenic projector units	all	rated life of lamp used	—

*When available in test wattage.

the terminology employed in presentation of data.

2. General Information to be Reported

(a) The data sheet carrying test performance data shall note: the name of the manufacturer of the lighting unit; its catalog number or identification; trade name if any; and a description of the type of unit such as "ellipsoidal reflector spotlight," "striplight," etc.

(b) The test performance data sheet shall note the date of test and the laboratory where it was performed.

(c) The manufacturer shall describe on the data sheet the following significant physical properties of the lighting unit:

(1) Major dimensions,
(2) Light source,
(3) Material of reflecting surface (or surfaces).
(4) Optical elements (light source, reflector, lens),
(5) Optical adjustments (light source, reflector, lens).

NOTE: Information about a unit's weight, optical adjustment mechanism, and normally included wiring and accessories would be helpful.

3. Light Source Information to be Reported

(a) The following information concerning the test lamp shall be reported:

(1) Nominal wattage of lamp,
(2) Design voltage of lamp,
(3) Rated life of lamp in hours,
(4) Type of lamp filament,
(5) Initial lumen output of lamp (see (c) below),
(6) Bulb shape, size and base,
(7) Recommended burning position,
(8) Approximate initial color temperature in degrees Kelvin.

(b) While a manufacturer may report the performance of his equipment using any type of incandescent filament lamp he elects, he shall also include photometric data using one or more of the lamps described by the proper category in Table I.

(c) The photometric data for the lamp used in testing shall be corrected to conform with the estimated initial lumen output for the lamp as published in the *IES Lighting Handbook*, some of which data is reproduced in Appendix A* for convenience. In the event that a lamp is not specified therein, then the data shall be corrected to conform to the lamp manufacturer's published lumens and so stated.

4. Test Procedure for Obtaining Data

4.1—*General* — The test procedure in general shall conform to the pertinent sections of any or all of the following:

(a) I.E.S. Practical Guide to Photometry,**
(b) I.E.S. General Guide to Photometry,
(c) I.E.S. Guide for the Photometric Testing of Floodlights of 10 to 160 Degrees Total Beam Spread,
(d) I.E.S. Guide for Photometric Testing of Searchlights.

*Not published here — Data from third edition of the *IES Lighting Handbook*.
**In preparation.

4.2—*Minimum Requirements in Obtaining Photometric Data*

4.2.1—*Distribution Symmetrical Around the Optical Axis* — Data for each candlepower distribution curve shall be the average of readings in four planes common to the optical axis: the vertical, horizontal, and two 45-degree planes.

4.2.2—*Asymmetrical Distribution* — For any unit in which the distribution is intended to be asymmetrical about the optical axis, data for more than one curve shall be presented so as to show the asymmetry of the candlepower distribution.

4.2.3—*Number of Readings* — There shall be approximately twenty (20) readings per plane, distributed so as to describe the beam accurately.

4.3—*Test Conditions for Specific Lighting Units*

4.3.1—*Ellipsoidal-Reflector Spotlights* — The lens system is to be adjusted to its sharpest focus. The lamp is to be adjusted to produce a beam of greatest uniformity. The aperture shall be at its maximum opening.

4.3.2—*Fresnel-Lens Spotlights and Plano-Convex Lens Spotlights* — Separate groups of data shall be reported for at least two focus positions: (1) full flood, and (2) spot. These positions shall be designated by the manufacturer who may also designate additional focus positions.

4.3.3—*Variable Focal Length Multilens System Spotlights* — Separate groups of data shall be reported for at least two focus positions: (1) full flood, and (2) spot. These positions shall be designated by the manufacturer who may also designate additional focus positions.

4.3.4—*Variable Focus Parabolic—Reflector Floodlights* — Data shall be reported for the lamp filament at the focal point of the reflector. Additional data shall be reported for any other point (or points) that the manufacturer shall designate.

4.3.5—*Striplights* — Distribution curves for a single lamp and reflector combination and/or lens in the striplight shall be obtained for planes

TABLE II — Throw Distance for Illumination Curves as per Section 5.3.1.

Type of Equipment	Wattage	Distance
Fresnel-lens spotlight	75 - 150	5′
	250 - 750	15′
	1000 - 2000	20′
	5000: at spot focus	60′
	5000: at flood focus	30′
	10,000: at spot focus	60′
	10,000: at flood focus	30′
Ellipsoidal-reflector spotlight	250 - 750	20′
	1000 - 2000	30′
	3000 - 5000	50′
Plano-convex lens spotlight	250 - 400	10′
	500 - 1000	20′
	1500 - 2000	20′
Follow spotlight	all sizes	100′
Floodlights and scoops	300 - 500	10′
	750 - 2000	15′
Parabolic-reflector projectors	250 - 750	25′
	1000 - 2000	50′
PAR and R reflector lamps in housings	all sizes	15′
Striplights	all sizes	see computation required in 4.3.5
Scenic projection units	all sizes	20′

through the maximum candlepower axes, parallel and perpendicular to the long dimensions of the striplight. In addition footcandle computations showing the additive effect obtained from a number of lamp units placed at the lamp spacings for a single circuit used by the manufacturer, shall be reported for throw distances of 5 feet and 15 feet on a line parallel with the striplight.

4.4—*Spectral Determination* — It is desirable that the spectral distribution curve be provided for each lighting unit tested, using the light sources indicated in the schedule of Table I.

5. Photometric Information to be Presented

5.1—*General* — Candlepower and illumination curves, field angle,* beam angle,** the total lumens in the field, and the total lumens in the beam shall be presented.

5.2—*Candlepower Distribution Curve* — **(a)** A candlepower distribution curve (or curves if required) shall be presented for each lighting unit. Such curves are to be plotted on rectilinear coordinates and shall be an accurate candlepower profile of the unit's light distribution taken on a spherical surface. The curves are to be plotted using candlepower as the ordinate versus degrees as the abscissa.

(b) The candlepower distribution curve of each lighting unit shall be referred to the mechanical axis of the unit and shall extend beyond the point where the candlepower is 10 per cent of maximum candlepower.

5.3—*Illumination Curve* — An illumination curve (or curves if required) shall be presented for each lighting unit. Such curves are to be plotted on rectilinear coordinates, and shall be calculated from the candlepower distribution curve for the single instance of a plane perpendicular to the mechanical axis at a given throw distance from the lighting unit. The curves are to be plotted using footcandles as the ordinate versus feet as the abscissa.

5.3.1—*Throw Distance* — The illumination curve or curves for the lighting unit is to be plotted at the throw distance indicated in Table II.

5.4—*Conversion Factors* — **(a)** Multiplying factors for conversion of the illumination curve data for use at other throw distances shall be provided as shown in Appendix B.

(b) The following statement shall appear on the test Performance Data Sheet: "To convert the candlepower distribution curve (or curves) to illumination curve (or curves) on a spherical surface with the lighting unit as its center, divide the candlepower values by the square of the radius (throw distance) in feet. (Invalid at less than —— feet.)" The distance reference shall be twenty times the lens diameter of the lighting unit. In the case of lensless lighting units the diameter of the reflector may be considered as the effective diameter.

5.5—*Field and Field Angle* — Those points of the curve where the candlepower is 10 per cent of maximum candlepower shall define the field of the lighting unit. The included angle shall be defined as the field angle.

5.6—*Beam and Beam Angle* — Those points of the curve where the candlepower is 50 per cent of maximum candlepower shall define the beam of the lighting unit. The included angle shall be defined as beam angle.

*See Section 5.5.
**See Section 5.6.

APPENDIX A—TECHNICAL INFORMATION ON LAMPS USED FOR TESTING AND REPORTING DATA will appear in the reprint of this report.

APPENDIX B — CONVERSION FACTORS AS PER SECTION 5.4 (a).

Multiplying factors for conversion of the illumination curve data for use at other throw distances are provided on the next page. It should be noted that these values may be considered accurate only when there is a minimum ratio of 20:1 for the object-to-lens distance as compared with the lens diameter. In the case of lens-less lighting units the diameter of the reflector may be considered as the effective diameter.

Curve Throw Distance	Actual Throw Distance	Multiply Dimensions by	Multiply Illumination by
5 feet	5.0 feet	1.0	1.0
	7.5	1.5	0.44
	10.0	2.0	0.25
	12.5	2.5	0.16
	15.0	3.0	0.11
10 feet	7.5 feet	0.75	1.8
	10.0	1.0	1.0
	15.0	1.5	0.44
	20.0	2.0	0.25
	25.0	2.5	0.16
	30.0	3.0	0.11
15 feet	10.0 feet	0.66	2.25
	15.0	1.0	1.0
	20.0	1.3	0.56
	25.0	1.7	0.36
	30.0	2.0	0.25
	40.0	2.7	0.14
	50.0	3.3	0.09
20 feet	10 feet	0.5	4.0
	15	0.75	1.8
	20	1.0	1.0
	25	1.25	0.64
	30	1.5	0.44
	35	1.75	0.32
	40	2.0	0.25
	50	2.5	0.16
25 feet	10 feet	0.4	6.3
	15	0.6	2.8
	20	0.8	1.5
	25	1.0	1.0
	30	1.2	0.69
	35	1.4	0.51
	40	1.6	0.39
	50	2.0	0.25

Curve Throw Distance	Actual Throw Distance	Multiply Dimensions by	Multiply Illumination by
30 feet	10 feet	0.33	9.0
	15	0.5	4.0
	20	0.67	2.25
	25	0.83	1.44
	30	1.0	1.0
	35	1.16	0.73
	40	1.3	0.56
	45	1.5	0.44
	50	1.7	0.36
	60	2.0	0.25
50 feet	25 feet	0.5	4.0
	40	0.8	1.5
	50	1.0	1.0
	60	1.2	0.69
	75	1.5	0.44
	100	2.0	0.25
60 feet	20 feet	0.33	9.0
	30	0.5	4.0
	40	0.67	2.25
	50	0.83	1.44
	60	1.0	1.0
	70	1.16	0.73
	80	1.3	0.56
	90	1.5	0.44
	100	1.7	0.36
100 feet	50 feet	0.5	4.0
	75	0.75	1.8
	100	1.0	1.0
	125	1.25	0.64
	150	1.5	0.44
	175	1.75	0.32
	200	2.0	0.25

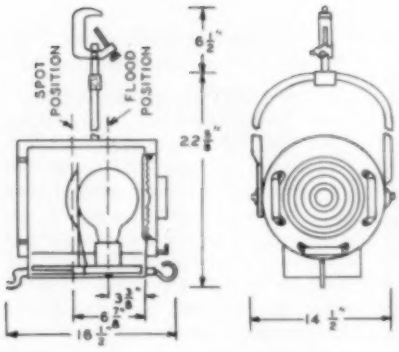
Appendix C—A Typical Form for a Data Sheet

Lighting Equipment Performance Data Sheet

Manufacturer's Company Name: XYZ Laboratories

Catalog No. or Identification: 2735 Trade Name: Fres-Light

Type of Unit: Fresnel-lens Spotlight



Physical Properties

Light Source: Incandescent Filament Lamp

Optical Elements

Lens: 8 x 5 Fresnel, heat-resisting, painted risers

Reflector: specular Alzak, spherical spun reflector, 5" diameter

Other:

Optical Adjustments: Relation between lamp and reflector fixed. Lamp carriage moves with relation to lens for spot to flood position

Adjustment Mechanisms: screw feed drive for crank and pole operation

Weight of Unit: 25 pounds

Wiring and Accessories: 30" asbestos leads, 2-wire or 2-wire plus ground

Test Lamp Data

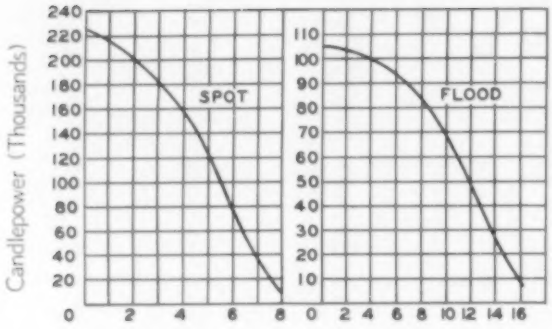
Lamp Designation	2M/G48/17	Initial Lumens	53,000
Nominal Watts	2000	Bulb Shape and Size	G48
Design Volts	120	Base	mogul bipost
Rated Life	200 hours	Recommended Burning Position	base down
Filament Form	C13		

Approximate Initial Color Temperature: 3150°K

Test Date	-----	Test Laboratory	XYZ Laboratories
Report No.	683	Approved by	XYZ

Photometric Test Data

Candlepower Distribution

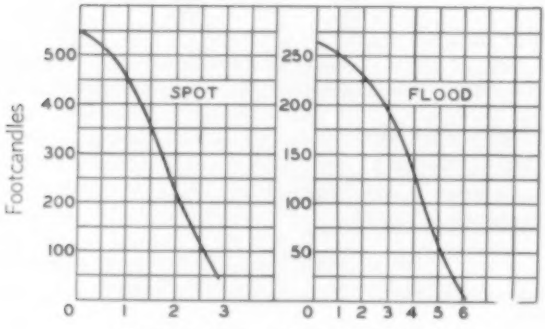


Degrees from mechanical axis

Illumination on a Plane at Right Angles to the Mechanical Axis of the Lighting Unit
Calculated for 20 feet throw distance

	Flood	Spot
Field Angle	31°	15°
Field Lumens	13,500	6,200
Beam Angle	24°	11°
Beam Lumens	11,700	5,050

Note: Candlepower curve(s) determined from data taken at 30 feet.



Distance from mechanical axis in feet

Illumination on a Spherical Surface

Multiplying Factors

Actual Throw Distance	Multiply Dimensions By	Multiply Illumination By
10	0.5	4.0
15	.75	1.8
20	1.0	1.0
25	1.25	.64
30	1.5	.44
35	1.75	.32
40	2.0	.25
50	2.5	.16

To convert the candlepower distribution curve (or curves) to illumination curve (or curves) on a spherical surface with the lighting unit as its center, divide the candlepower values by the square of the radius (throw distance) in feet. (Invalid at less than 14 feet.)

LIGHTING NEWS

Gold Medal Nominations Due January 1

According to official IES procedures, nominations for the Gold Medal Award for 1959 must be received at the headquarters office by January 1.

Nominees need not be members of the Society, nor citizens of the United States or Canada, and may be nominated at any time by any member of the Society, by presenting to the General Secretary the name of the individual whose accomplishments in his field are deemed worthy of such recognition. This field may be engineering, design, applied illumination, optics, ophthalmology, lighting research, education, or administration and management. Nominations and records from previous years, as reviewed and referred to the following year's committee, are given consideration along with new nominations.

The Gold Medal, the Society's highest award, is given "for the purpose of giving recognition to meritorious achievement which has conspicuously furthered the profession, art or knowledge of illuminating engineering." It is accompanied by an appropriately embossed parchment certificate of award.

Recipients of the award since its establishment in 1944 have been: George H. Stickney, Preston S. Millar, E. C. Crittenden, Matthew Luckiesh, Sir Clifford Paterson, Ward Harrison, W. F. Little, H. H. Magdsick, E. F. Lowry, J. L. Stair, Dr. George S. Crampton and Professor John O. Kraehenbuehl. Recipient of the honor this year is C. A. B. Halvorson. No awards were made in 1951 and 1953.

Russian Journals Now Published in English

Approximately 60,000 pages of key Soviet scientific and technical journals are now available in English translation. In announcing this information, the National Science Foundation stated that there are now in print 53 English editions of Russian journals, 4 extensive series of abstracts of Russian papers and 4 series of partial translations of important Journals.

Support for this translation activity is provided by several government agencies and by six commercial translating firms, working without government funds.

The first Russian-English translation program was initiated by the National Science Foundation in 1952 and there are now 31 journals being translated with the support of Foundation funds. Translation projects are conducted in the United States by scientific societies and university groups, who choose the material and then request Foundation support. These journals are sold on a subscription basis with the resulting income used to defray partial cost of the projects.

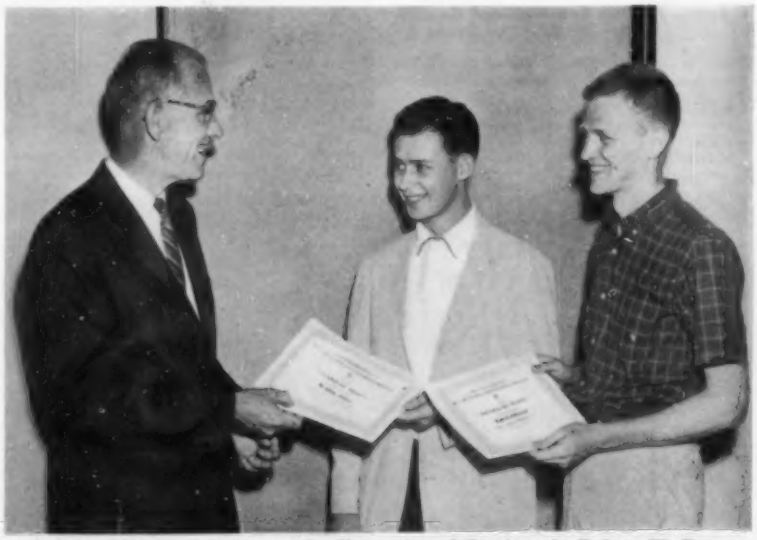
A complete list of the material available, names and addresses of publishers and the annual subscription rates may be obtained from the Office of Scientific Information, National Science Foundation, Washington, D. C.

Ohio Valley Section Holds Fourth Allied Arts Contest

Problem for the 1958 Allied Arts competition, held at the University of Cincinnati and sponsored by the Ohio Valley Section of IES, was the design of a small museum for traveling exhibits. The contest was given for fourth-year architectural students, and two top prizes of $50 each were awarded. Winners were H. William Nilsen and Robert Goodman. Second prizes of *IES Lighting Handbooks* were presented to Don Stevens and George Kurilko. Certificates of honorable mention were given to Robert E. Kennedy and Clifford Meyers.

Judges for the competition were Professor Robert W. Dayton of the University and Robert W. Brown and Leonard P. Cohron, representing the Illuminating Engineering Society.

Prior to participating in the competition, the students made a one-day tour of the General Electric Lighting Institute at Nela Park.



ALLIED ARTS Competition at the University of Cincinnati. Robert W. Brown, representing IES, presents certificates to first place winners H. W. Nilsen and Robert Goodman.

Here and There With I.E.S. Members

INCOMING Iowa Section Chairman, E. W. Schoenherr, at left in photo at left, accepting congratulations from outgoing Chairman, Mel Gailbraith. Photo at right: incoming Secretary, Dick Gruhl with new Vice-Chairman, Mary Stafford.

HEAD table at the New England Section's annual President's Night. L. to r.: Mrs. Richard Smith, R. L. Smart, Mrs. Walter Ball, President Reid, Mrs. Reid, Walter Ball, Section Chairman; Mrs. R. L. Smart, Edward Kassman, incoming Chairman; Alice Moran, Richard Smith.

NEW and old officers of South Pacific Coast Region held an all-day meeting at Monterey, Calif. to discuss forthcoming year's activities. Carleton Thompson, outgoing Regional Veep (seated center), presided. At his left is James Barnes, newly elected Regional Vice-President.

IES members wearing a different hat. Shown here as members of the Safe Highway Lighting Committee of NEMA's Street and Highway Safety Lighting Bureau are, left to right: A. D. Harrington, R. R. Schroeder, E. C. Powers, Stacy Standler, T. J. Ryan, Dana Rowten, Chairman of the IES Roadway Committee and E. V. Bailey.

IES Membership Increases During Year

According to the report of the General Board of Examiners at the July 17-18 Council Executive Committee Meeting, Society membership has increased by approximately 3 per cent in the 1957-1958 year. With the election of 21 Members and 57 Associate Members in July, present figures as compared with September 1957 figures are as follows:

September 30, 1957		July 17, 1958
8726	Total Membership	8984
29	Merber Emeritus	29
11	Fellow Emeritus	12
106	Fellows	113
2212	Members	2410
6211	Associate Members	6304
157	Student Members	116

ISCC Membership Roster Now Available

The Inter-Society Color Council has recently published a complete official roster for 1958-59. Included in the listing are the society officers for the coming year, member organizations and their delegates, associate individual members (those who belong to a member body), affiliate individual members (not belonging to a member body) and the addresses of all the afore-mentioned individuals. A list of Standing Committees and their membership, as well as subcommittees now active on various problems is also included.

Copies of this roster may be obtained from Ralph M. Evans, Secretary, ISCC, Eastman Kodak Co., Color Technology Division, Bldg. 65, Rochester 4, N. Y.

Training Program Announced For Technical Secretaries

A new "speeded-up" training program to develop technical secretaries for scientists and engineers has been announced in Washington, D. C. The TESTS (Technical-Engineering-Scientific-Training-for-Secretaries) program has been designed specifically to help relieve the shortages of scientific and technical manpower. It is a special accelerated 90-week course to be offered by leading independent business colleges across the country. Textbooks cover the major engineering-scientific fields, basic science, mathematics and drafting in easy-to-understand language.

Accelerated learning is the key to the training program. Special field trips are arranged for the students, according to the announcement. Through the Central TESTS Library, kinescopes, films, film-

(*Continued on page* 14A)

SCHEDULED EVENTS

September 22-25, 1958 — Institute of Traffic Engineers (Annual Meeting), McAllister & Columbus Hotels, Miami, Florida.

October 8-10, 1958 — Canadian Electrical Manufacturers Association (14th Annual Meeting), Sheraton Brock Hotel, Niagara Falls, Canada.

October 10-11, 1958 — International Association of Electrical Inspectors (Canadian Section), Toronto, Ont.

October 13-14, 1958 — U. S. National Committee of the International Commission on Illumination (C.I.E.), Annual Meeting, Nittany Lion Inn, State College, Pa.

October 13-15, 1958 — National Electronics Conference, Inc., Hotel Sherman, Chicago, Ill.

October 19-24, 1958 — Society of Motion Picture and Television Engineers, Sheraton-Cadillac Hotel, Detroit, Mich.

October 20-24, 1958 — National Safety Council (46th National Safety Congress & Exposition), Chicago, Ill.

October 27-31, 1958 — American Institute of Electrical Engineers (Fall General Meeting), Pittsburgh, Pa.

November 10-14, 1958 — National Electrical Manufacturers Association (Annual Meeting), Traymore Hotel, Atlantic City, N. J.

November 17-21, 1958 — Eighth Annual Plastics Exposition and National Conference of the Society of the Plastics Industry, Inc., International Amphitheater, Chicago, Ill.

November 18-20, 1958 — American Standards Association (9th Annual Conference on Standards), Hotel Roosevelt, New York, N. Y.

December 11, 1958 — Council Meeting, Illuminating Engineering Society, New York, N. Y. Members are free to attend meetings of Council as guests.

January 19-23, 1959 — American Institute of Electrical Engineers (Winter General Meeting), New York, N. Y.

February 8-14, 1959 — National Electrical Week.

February 12, 1959 — Council Meeting, Illuminating Engineering Society, New York, N. Y. Members are free to attend meetings of Council as guests.

March 1-4, 1959 — Second National Lighting Exposition, New York Coliseum, New York, N. Y.

March 1-4, 1959 — National Electric Sign Association, Morrison Hotel, Chicago, Ill.

March 24-26, 1959 — First Biennial Chicago Electrical Industry Show, Hotel Sherman, Chicago, Ill.

March 30 - April 1, 1959 — Chicago Electrical Industry Show, Hotel Sherman, Chicago, Ill.

April 2-3, 1959 — East Central Regional Conference, Lord Baltimore Hotel, Baltimore, Md.

April 22, 1959 — Council Meeting, Illuminating Engineering Society, Asheville, N. C. Members are free to attend meetings of Council as guests.

April 22-24, 1959—South Central and Southeastern Regional Conference, Grove Park Inn, Asheville, N. C.

May 3-8, 1959 — Society of Motion Picture and Television Engineers, The Fontainbleau, Miami Beach, Fla.

May 4-5, 1959 — Southwestern Regional Conference, Shamrock-Hilton Hotel, Houston, Tex.

May 6-8, 1959 — Midwestern Regional Conference, Pere Marquette Hotel, Peoria, Ill.

May 11-12, 1959 — Inter-Mountain Regional Conference, Continental Hotel, Denver, Colo.

May 24-29, 1959 — National Association of Electrical Distributors (51st Annual Convention), Conrad Hilton Hotel, Chicago, Ill.

May 26-30, 1959 — Pacific Northwest Regional Conference, Banff Springs Hotel, Banff, Alta.

June 4-5, 1959 — Northeastern Regional Conference, Curtis Hotel, Lenox, Mass.

June 11, 1959 — Council Meeting, Illuminating Engineering Society, New York, N. Y. Members are free to attend meetings of Council as guests.

June 11-12, 1959 — Canadian Regional Conference, Chateau Laurier, Ottawa, Ont.

June 22-23, 1959 — Great Lakes Regional Conference, Statler Hotel, Buffalo, N. Y.

June 22-26, 1959 — American Institute of Electrical Engineers, Summer and Pacific General Meeting, Seattle, Wash.

I.E.S. National Technical Conferences

1959 — September 7-11 — Hotels Fairmont and Mark Hopkins, San Francisco, California

1960 — September 11-16 — Penn Sheraton Hotel, Pittsburgh, Pennsylvania

1961 — September 24-29 — Chase Park Plaza Hotel, St. Louis, Missouri

1962 — September 9-14 — Statler-Hilton Hotel, Dallas, Texas

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A new and important tool in the hands of those who set new trends in illuminating engineering.

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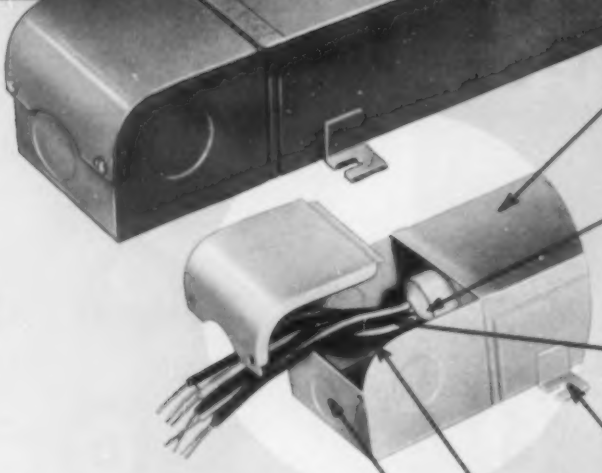


- ***WEATHERPROOF, CORROSION-PROOF CASE***
  Entire case is hot-dip galvanized — one of the most durable, corrosion-resistant finishes available. After ballast assembly, the seams of the lid are brazed to form a completely sealed unit.
- ***AQUALIFT SEALED PIPE NIPPLE***
  Aqualift Sealant—a Jefferson-developed sealing compound — prevents moisture from entering through the pipe nipple that provides an exit for the ballast leads. The Aqualift Sealant retains its sealing properties thru extremes of heat and cold.
- ***NEOPRENE LEADS***
  Neoprene leads will withstand exposure to weather and temperature changes without deterioration. Another example of the excellent quality of materials in the Nor'easter ballast.
- ***HEAVY GAUGE MOUNTING***
  The Nor'easter ballast is provided with extra heavy mounting brackets for safer and more reliable mounting.

MODELS AVAILABLE

FOR 800 M.A. Lamps

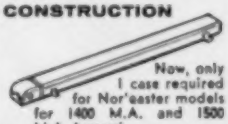
Catalog No. 257-111	Any two lamp combination of: 24T12/HO, or 36T12/HO, or 48T12/HO.
Catalog No. 257-141	Any two lamp combination of: 72T12/HO, or 96T12/HO.

FOR 1400 M.A. and 1500 M.A. Lamps

Catalog No. 257-121	2 lamp 48PG17/RS, 48T12/VHO, 48T12/SHO.
Catalog No. 257-131	2 lamp 72T12/VHO, 72PG17/RS, 72T12/SHO, or 96T12/VHO, 96PG17/RS, 96T12/SHO.

We will match customer's color sample on orders of 100 or more. Standard unit light machine gray ASA #61.

ONE CASE CONSTRUCTION



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- ***LARGE, EASILY ACCESSIBLE WIRING COMPARTMENT***—open on *two sides*—conduit lock nuts can be easily secured on inside of compartment.
- ***FOUR KNOCKOUTS***—Conduit may be brought through *either side, bottom,* or directly into *end* of ballast. All knockouts take ¾" conduit.

FOR SIGNS—This ballast can be mounted *outside* signs in *direct exposure* to all weather.

MAIL THIS COUPON NOW FOR COMPLETE INFORMATION including temperature ratings, dimensions, weights and electrical specifications.

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Gentlemen: Please send me complete data on the new Jefferson Nor'easter Fluorescent Ballasts.

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For exceptional appearance, design choice, maximum life and maintenance economy, specify Union Metal MONOTUBE lighting poles.

Steel or aluminum . . . round or fluted . . . davit or bracket type design . . . anchor or transformer base . . . Union Metal's half-century of experience is your guarantee of complete satisfaction.

Catalog information is readily available. Write The Union Metal Manufacturing Company, Canton 5, Ohio. In Canada: The Union Metal Manufacturing Company of Canada Limited, Brampton, Ontario.

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Modern Monotube davit lighting poles and overhead sign supports help speed traffic and reduce accidents along Baltimore's new 17 mile—130 million dollar expressway system.

LIVE BETTER ELECTRICALLY

MEMBERS of the "Lamplighters," Golden Gate Streetlighting Subcommittee, left to right: Grant Radford, Jim Burson, Dick Smith, Harold Skootsky, Gib Trosper, Don Jones, Verne Waight and Bruce Kunde. Missing from photograph is committeeman Jim Wrathall.

(Continued from page 9A)

strips, slides and tapes on the latest engineering processes and scientific advances are rotated among the schools. Each student is provided with copies of the latest product brochures.

Segments of the program are available in special three-month training cycles for currently employed secretaries. Also, flexible arrangements can be made for in-service training. Further information on the program is available from a booklet to be obtained from Technical Engineering Training, Dupont Circle Building, Washington 6, D. C.

Modular Bibliography Issued By Standards Group

Publication of a complete bibliography dealing with the modular system of coordination for buildings and building construction products has been completed by the Modular Building Standards Association. This is the first such bibliography to be compiled since the American Institute of Architects undertook the task in 1950.

The Modular Building Association, which was formed last year, supports the work of ASA Committee A62 for modular coordination. The group is headed by Cyrus Silling, Charleston, W. Va. architect, who is also chairman of the ASA Sectional Committee.

Free copies of the bibliography can be obtained from MBSA headquarters, 2029 K Street, N. W., Washington 6, D. C.

Golden Gate Section Holds Street Lighting Meeting

More than 100 people, most of whom were city, county and highway officials and engineers, attended the highly successful 1958 annual street lighting dinner-meeting of the Golden Gate Section. The program, conducted by the "Lamplighters," street lighting subcommittee of the Section, began with a skit dramatizing the position that street lighting should hold in community planning. Also pointed out in the skit was the possibility of coordinating street lighting and tree trimming to improve the appearance of a neighborhood.

Following the skit was a panel discussion in which representatives of county and municipal governments discussed and answered questions from the audience.

At the conclusion of the meeting copies of the various California street and highway lighting acts were given to the members of the audience to serve as source material for future reference and as reminders of the things yet to be done in street lighting.

Circular Slide Rule Offered — Free

A handy pocket-size circular slide rule is now available, without charge, from the General Industrial Co., 5738 Elston Ave., Chicago, Ill. Simple calculations are quickly and easily performed with this instrument which should be useful to engineers and other plant and office executives. Of course, a complete set of operating instructions will be enclosed with each slide rule.

First a-c Installation Commemorated in Buffalo

America's first commercial installation of an alternating current electrical system, which took place in Buffalo on November 26, 1886, was celebrated June 24 at the Summer General Meeting of the American Institute of Electrical En-

(Continued on page 21A)

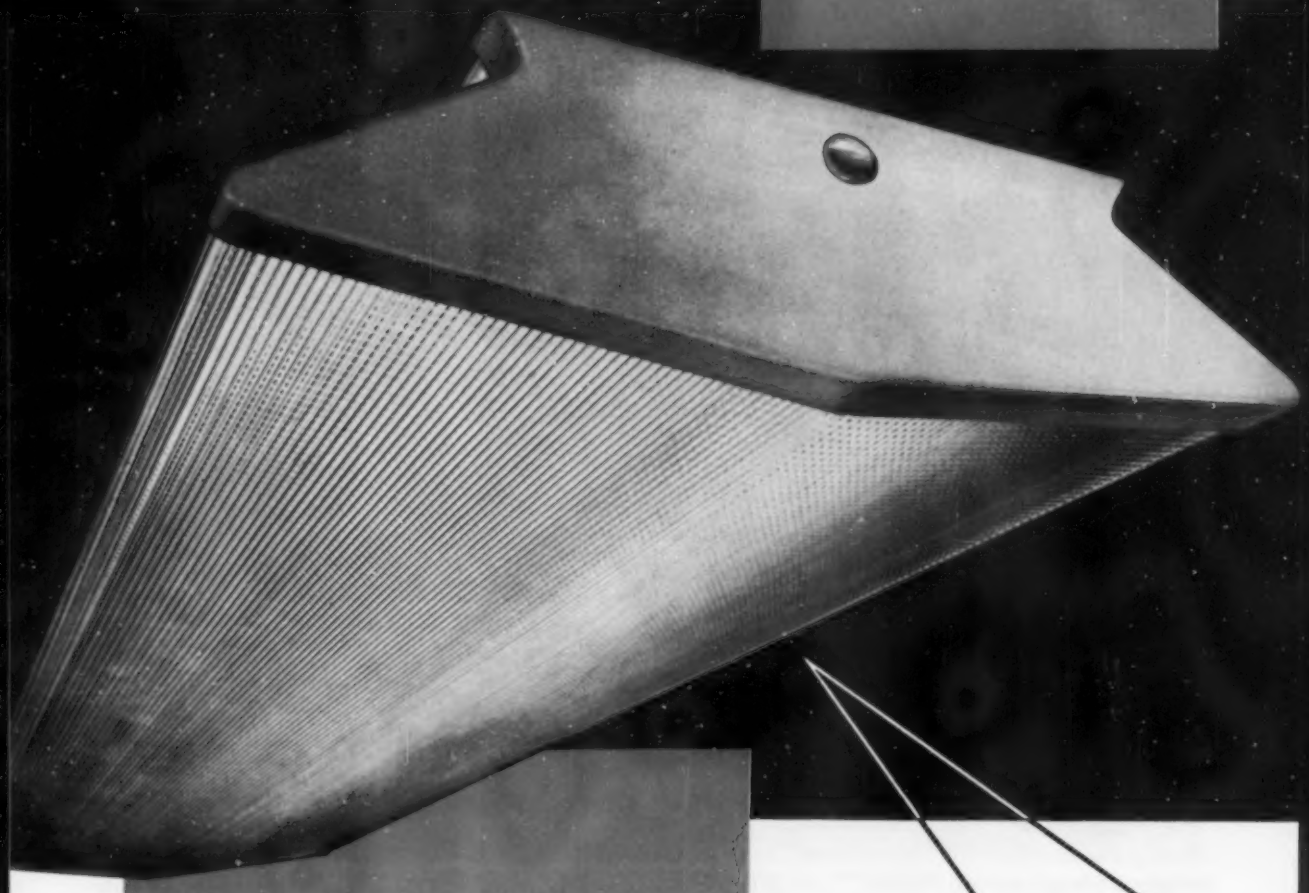
1959 Regional Conferences — I.E.S.

Region	Place	Date
East Central	Lord Baltimore Hotel Baltimore, Md.	April 2-3
South Central and Southeastern	Grove Park Inn Asheville, N. C.	April 23-24
Southwestern	Shamrock-Hilton Hotel Houston, Texas	May 4-5
Midwestern	Pere Marquette Hotel Peoria, Ill.	May 6-8
Inter-Mountain	Continental Hotel Denver, Colo.	May 11-12
Pacific Northwest	Banff Springs Hotel Banff, Alta.	May 26-30
Northeastern	Curtis Hotel Lenox, Mass.	June 4-5
Canadian	Chateau Laurier Ottawa, Ont.	June 11-12
Great Lakes	Statler Hotel Buffalo, N. Y.	June 22-23

more's new 17 mile–130 million dollar expressway system.

Something Really *Different* in Fluorescent Lighting . . .

SABRE by miller



Here is a fresh approach to the design concept of *on-the-ceiling* fluorescent lighting. Sabre by Miller has styling, comfort, and high efficiency that meet the needs of modern stores, offices, and schools — interiors of all kinds.

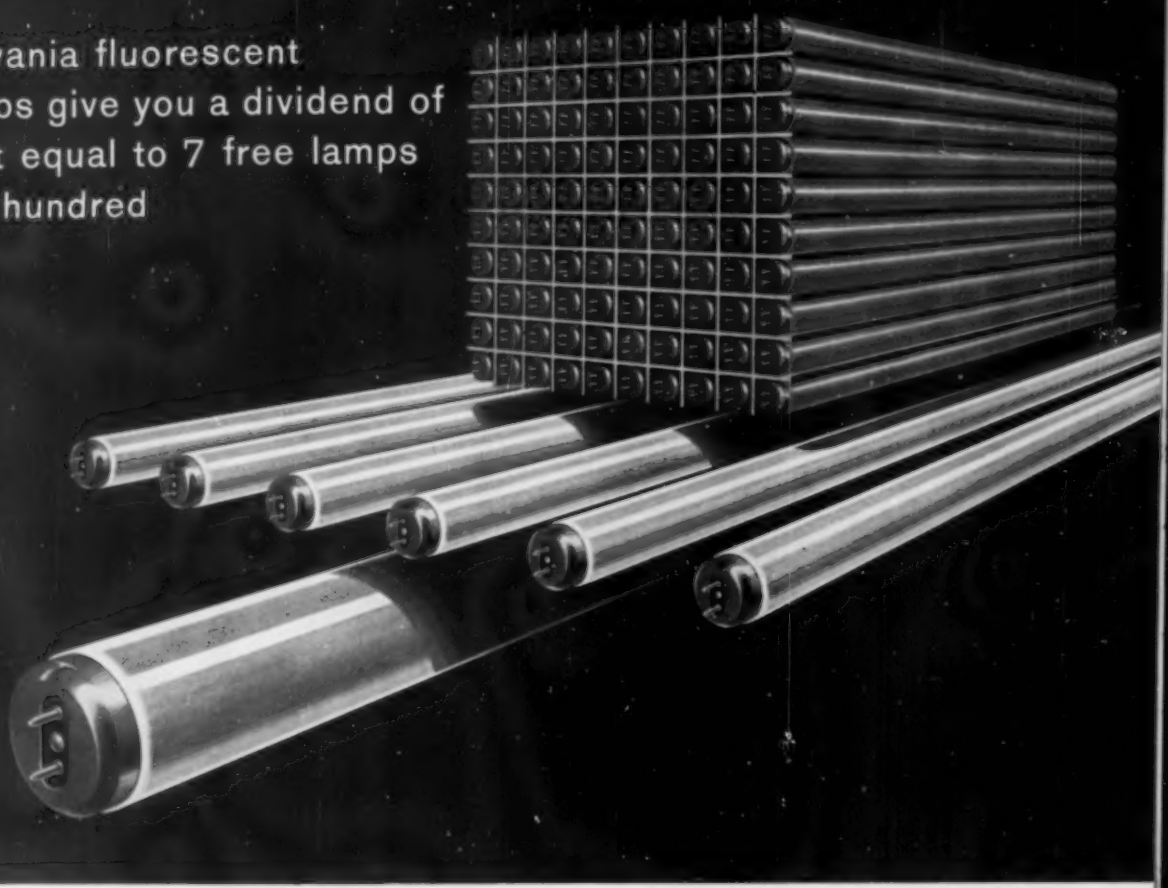
Sabre's shallow depth and sweeping "Flite-Line" Styling blend to enhance the appearance and decor of any interior. *Efficiency of 74.5%* means fewer fixtures per footcandle are needed to make today's high lighting levels practical.

Sabre's carefully engineered, one-piece wrap-around *refractor of* prismatic, crystal-clear plastic provides added sparkle, and excellent brightness control. Viewing is comfortable from all angles. Maintenance is easy.

And, this unique combination of features comes at a truly popular price. Discover today, how the new Sabre can meet your specific lighting design and installation needs. Write Dept. 938-E, The Miller Company, Meriden, Conn. for complete performance and specification information, or contact your Miller Representative for a physical demonstration.

miller
SINCE 1844

THE **miller** COMPANY • MERIDEN • CONN.



Sylvania fluorescent lamps consistently deliver more light throughout useful life

Another reason why

Sylvania Fluorescents give you more light at lower cost than all other brands

Advanced engineering makes Sylvania fluorescent lamps superior in many ways—makes light a better tool of production to increase profits

Sylvania lamps deliver more light when new. And they continue to maintain their greater light output throughout useful life by as much as 7%.

For example, at 3,000 hours, in a single-shift operation, 100 Sylvania lamps deliver the light output of about 107 ordinary fluorescents. In effect, you get a Sylvania dividend of light equal to 7 free lamps.

Moreover, this dividend of light means you get more light-per-lamp from the power you buy.

Because of their greater maintained light output, Sylvania fluorescent lamps offer more opportunities for economy. They extend the period between lamp replacements... they reduce work interruption . . . and cut labor costs.

This is another example of how Sylvania builds extra value into fluorescent lamps to help cut your lighting and operating costs.

Let your local Sylvania Representative show you how Sylvania's superiority can save you time and money. Call him today or write:

SYLVANIA LIGHTING PRODUCTS
Division of SYLVANIA ELECTRIC PRODUCTS INC.
60 Boston St., Dept. 8L-3509, Salem, Mass.
In Canada: Sylvania Electric (Canada) Ltd.
Shell Tower Building, Montreal

SYLVANIA Lighting Products

make light a better tool for profits

LIGHTING • TELEVISION • RADIO • ELECTRONICS • PHOTOGRAPHY • ATOMIC ENERGY • CHEMISTRY-METALLURGY

4'-square PLEXIGLAS diffusers at Park Avenue office of a large New York City bank

PLEXIGLAS

...for lighting that stands out and stands up

For lighting equipment that matches the beauty of a handsome interior, choose luminaires incorporating PLEXIGLAS® acrylic plastic. Then you can be sure of clean, uncluttered appearance, and highest efficiency in transmission and diffusion. You can also be sure these advantages will last, because PLEXIGLAS has freedom from discoloration, resists breakage, is a rigid material with a smooth, easily cleaned surface.

We will be glad to send you white translucent samples and a copy of our brochure, "Architectural Lighting with PLEXIGLAS".

Chemicals for Industry

ROHM & HAAS COMPANY

WASHINGTON SQUARE, PHILADELPHIA 5, PA.

Representatives in principal foreign countries

Canadian Distributor: *Crystal Glass & Plastics, Ltd., 130 Queen's Quay East, Toronto, Ontario, Canada.*

LTG-30
P&K outdoor packaged lighting units make the job easier
a universal outdoor lighting fixture
for post-top or slip-fitter side mount
this 8 page booklet tells you what you want to know
CIRCLElux luminaire
IN THIS CATALOG
PAGE
the CIRCLElux 2
electrical characteristics 3
post-top mount . . . specifications and photometric data 4 & 5
slip-fitter side mount . . . specifications and photometric data 6 & 7
advisory service 8

MORE FACTS ABOUT "PACKAGED" OUTDOOR LIGHTING

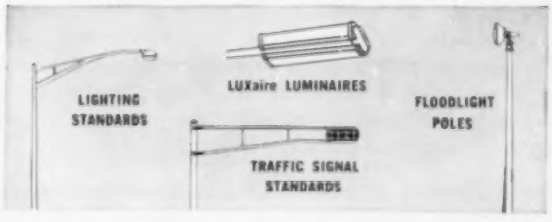
Having created a new concept in outdoor lighting with the development of "packaged" units P & K now brings a wealth of new information to the field. Basically, a "packaged" unit is one in which both standard and lighting unit are supplied together by the same manufacturer. The advantages are obvious: simplification of ordering and specifying, reduced shipping and handling costs, ease of assembly and installation. What's most important, however, is the fact that these handsome all-aluminum standards are available in straight and davit styles, in a wide range of sizes, and can be obtained with a choice of three light sources—incandescent, fluorescent or mercury vapor. In this way it is possible to customize any installation with standard units assembled to your specifications.

Now, in this helpful booklet P & K has provided all the facts you want on CIRCLElux units—catalog numbers, lighting curves, electrical characteristics, etc. Write for your copy of LTG-30 today.

P&K

PFAFF & KENDALL

84 FOUNDRY STREET, NEWARK 5, N. J.

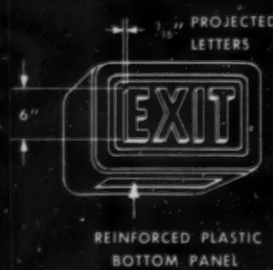


POINT THE WAY

with NEW, PROJECTED LETTER

FLUORESCENT EXIT UNITS by PERFECLITE

SURFACE TYPE UNIT



Check These Superior Features:

Phosphorescent Lucite panel gives ½ hour after-glow should the circuit become dead. 6" projected letters. Available in models for all surface type as well as recessed installations. Mounted from top, back, side or from a pendant. Surface models are also available for either single or double face use. Pivot hinged, die formed 20 ga. steel frames for easy servicing. Surface type boxes are made of 18 ga. press drawn steel, ½" KO's top and side. Recessed boxes are of 20 ga. press drawn steel, six ½" KO's.

Lucite faces available in 4 color combinations — with or without arrows. Completely wired for two T-5 6-watt lamps, 118-V. AC ballasts. Also available for use in 277-V. systems.

You reduce installation costs, make every building safer when you select Perfeclite unbreakable projected letter fluorescent exit signs. For further information, mail the attached coupon today!

PERFECLITE PRODUCTS — THE MARK OF LIGHTING SERVICE

Units are Underwriters' Laboratories, Inc., approved, and comply with National Electrical Code.

THE PERFECLITE COMPANY

1437 EAST 40th STREET • CLEVELAND 3, OHIO

Please send me the Perfeclite Data Folder EX-58 C.

NAME _____

ADDRESS _____

CITY _____ STATE _____

How to Light the Fingers of the AMERICAN STOCK EXCHANGE

...With Planned Lighting

Rambusch lighting engineers were given the difficult task of lighting the trading floor of the American Stock Exchange where finger signals from telephone attendants, seated in the gallery, must be distinctly seen and correctly interpreted by their colleagues on the floor—as much as 150 feet away. Added to this the engineers had to make sure that the image of a moving ticker tape projected on a large screen would not be washed out by a splash of strong light.

The solution proved an excellent example of planned lighting where relative brightness is much more important than foot-candle intensities. Some sixty 500-watt narrow beam Rambusch Annulites were installed giving good light intensity on the trading floor without splashing bright light on the screen. Now the projected image of the moving ticker tape stands out in legible contrast against a darkened wall. At the same time, the acute task of seeing finger signals at a glance more than 150 feet away is carried out in simple order.

The members of the American Stock Exchange now do an important job better—with good light. Rambusch lighting engineers are ready with suggestions and layouts to help make your job easier. Write today or contact the Rambusch representative nearest you for further details or a free consultation.

RAMBUSCH DESIGNERS MANUFACTURERS **40 WEST 13TH STREET, NEW YORK 11, N. Y.**

(Continued from page 14A)

gineers. A commemorative plaque was presented by the Institute to Adam, Meldrum & Anderson Co., in whose store the 1886 installation was made.

Principal speaker at the luncheon was A. C. Monteith, vice-president of Westinghouse Electric Corp., Pittsburgh, and former national president of AIEE.

Electrical Industry Problems On Safety Congress Agenda

Two sessions of the 46th National Safety Congress, to be held Oct. 20-24 at the Conrad Hilton Hotel in Chicago, will be devoted to the safety problems of the electrical industry and the industry's contribution to safety. Papers will be presented by Leslie D. Price, NEMA, New York, N. Y.; R. D. Barton, Underwriters'

(Continued on page 22A)

GARDEN lighting meeting of San Jose Chapter, held at the home of one of the members, included talks, slides and an actual demonstration garden. Shown here is Marion G. Herbert addressing the group.

leaves from the...

HISTORICAL COMMITTEE'S SCRAPBOOK

Light and Ancient Coins

Despite numerous allusions to light and radiation in ancient pagan and Christian records, (the Mazda high-priest of Zoroastrianism; the old Japanese sun-flag; the gospel statement "I am the light of the world," and many others), nevertheless it is truly rare that we find any relationships between light and ancient coins.

But there are two notable exceptions, coins that have been nearly lost to history, for they were popular media of trade some 2300 years before the Illuminating Engineering Society was founded.

Both coins were once well-known in the middle-east, and both will recall the history and the legends of times long forgotten, when Ulysses or Alexander or Saint Paul sailed into enchanted bays of the Dodecanese Islands of the eastern Mediterranean.

The first of these coins connected with lighting episodes (one in the possession of the writer and one in the Historical Museum of the Chase Manhattan Bank of New York) is a silver piece about the size and perhaps the former value of an American nickel (a drachma, more or less, if related to the Greek equivalent). On one face this bears the full visage of Helios, Greek God of Sunlight; on the other is a classic image of the then-known (wild) rose.

Both facts are interesting. The full-face cameo is rare, because almost all pictorial coins bear the *profile*, thus to permit a flatter disc that may be stacked. The image of a rose tells a tale of its place of coinage — the once famous Island of Rhodes, less than half the area of Rhode Island, but long famous for its roses (and attar of roses), and named therefor, in the Greek "Rhodon." From this name we recognize such derivatives as "rhododendron," the rose tree.

However, our pertinent history centers in the legends recorded by the inhabitants of Rhodes (who regarded themselves "children of the sun"), when they exploited that famous 195-foot lighthouse, the Colossus, which in the image of a man stood at the harbor entrance. This wonder of the ancient world was built by Chares of Lindus about 300 B.C., was shaken down by earthquakes in 224 B.C., and was carted off by 900 camels of a Saracen junkman, but not before this coin with its image of Helios, with its outstreaming "rays" of hair, had been minted there. Hence it is contemporaneous with the first most historical lighthouse!

As one holds this Rhodian image of the Sun-god in his hand, he wonders if it might have been a memorial to the Colossus, or paid in tribute to Alexander the Great when he invaded this island in 332 B.C., or even have rested in the tunic of St. Paul on one of his several voyages to this romantic spot.

The second coin is equally noteworthy. This two-drachma bronze piece, the "Bronze of Marcus Aurelius" (who ruled Rome 161-180 A.D.), commemorates another famous lighthouse, the Pharos of Alexandria. This structure was built by Sostratus in the reign of Ptolemy I (283-247 B.C.), and was felled by an earthquake long, long afterward, in the 13th Century.

This coin carries the clear view of the lighthouse erected in the Nile estuary, with its windows, its brazier of burning fagots, and its masonry detail. Sailing safely past and into Alexandria harbor is shown that most noted Egyptian goddess, Isis, wise "daughter of the earth and sky." Did the ancient gods need light to travel safely?

We may remember the connection of this coin with light, because the name "pharos" became the term for all historic lighthouses since that time. The image of Isis Pharia suggests a deification of light itself.

So from the faces of ancient coins we read bits of lighting history. Lighthouses of old — the first recorded "lighting fixtures" — may have served to guide many an early sailor, even legendary old Odysseus himself past the sirens and the rocky dangers, into safe harbors.

(*Continued from page* 21A)

Laboratories, Chicago; Marshall E. Kulberg, Sylvania Electric Products, Woburn, Mass. and Dr. Thomas S. Ely, U. S. Atomic Energy Commission, Washington, D. C.

It is expected that the Congress will attract over 12,500 safety specialists from the United States, Canada and several foreign countries.

Further information may be obtained from Jack Horner, Director of News, National Safety Council, 425 North Michigan Ave., Chicago 11, Ill.

E. W. Beggs

E. W. Beggs Retires After Career with Westinghouse

After nearly 40 years with the Lamp Division of Westinghouse Electric Corp., E. W. Beggs is taking advantage of his company's early retirement plan. His own plans are to "see America first," and he hopes to travel extensively.

Mr. Beggs joined Westinghouse in 1919 as a lamp design engineer, and at the time of his retirement he was Manager of Vapor and Fluorescent Lamps Section of the Commercial Engineering Department. During his career he developed many lamps, reporting upon some of them at IES National Technical Conferences. He is active on IES technical committees in several fields and was Chairman of the Progress Committee from 1953 to 1955. He is a Fellow of the Society and a member of the New York Section.

Raymond C. Kinney Retires Was Graybar Sales Manager

After 34 years with Graybar Electric Co., Raymond C. Kinney retired August 1. Mr. Kinney was manager of general lamp and lighting sales and was Graybar's Official Representative to IES. He has also been active on several IES Committees.

Mr. Kinney's current address is Sherbrooke Apt. 6, 2705 Riedling Drive, Louisville 6, Ky.

Ballasts To Be Studied by RLM, CBM, NEMA

The RLM Standards Institute, the Association of Certified Ballast Manufacturers and NEMA are considering the underwriting of an investigation into the causes of overheating of fluorescent fixtures and component parts. The investigation and report, if it is undertaken, will be made by an independent testing laboratory. It is hoped that this study will provide data for obtaining a reduction in luminaire operating temperatures and thus further advance the efficiency and economy of fluorescent lighting.

MEMBERS of the Toronto Section of I.E.S. at the "distribution gonio apparatus" at the recent opening of the Illumination Research Laboratory, J. A. Wilson Lighting & Display Ltd., in Toronto. Left to right: Canadian Regional Vice-President, J. Carl Wilson; Donald C. McCormack, Manager of product development and engineering for the company; and John M. Chorlton, Toronto Board of Education and Chairman of the Toronto Section, I.E.S.

ABOUT PEOPLE

Dr. George S. Crampton, IES 1956 Gold Medallist and former IES National President (1920-21) will receive the Edward Longstreth Medal from the Franklin Institute for his development of the borescope, a specialized periscope for the internal inspection of turbine shafts and various closed vessels. The medal will be presented to Dr. Crampton on Oct. 15 at formal ceremonies at the Institute.

George J. Taylor, incoming IES President has been invited to transfer to the grade of Fellow by the Board of Directors of AIEE. The citation presented to Mr. Taylor reads: "For contributions to the application of electrical lighting to industry."

Sheffield Plastics, Inc., Sheffield, Mass. has announced the appointment of **John E. Mullen** as vice-president in charge of purchasing and production. Prior to this appointment, Mr. Mullen had been office manager of the company.

Theodore Projector has resigned from the National Bureau of Standards to start his own consulting engineering organization. He is now located at 3304 Edgewood Road, Kensington, Md.

Corning Glass Works, Corning, N. Y. has appointed **George W. McLellan,** research physicist, to the position of coordinator of technical information service in the company's Division of Public

(*Continued on page* 38A)

Revere Outdoor Lighting Report

Revere ELECTRIC MFG. CO.

Lighting a store front

The Problem: To draw attention to a store front and make it look inviting to shoppers by providing high level, uniform lighting for the wall and sidewalk area.

The Answer: Revere 9605 Fluorescent Luminaires were installed to give the high level of illumination desired. Eight-foot units were joined to form a continuous, attractive light source that makes the store look inviting. Each 8-foot unit contains two Very High Output lamps and has two 4-foot doors for fast, easy cleaning and maintenance.

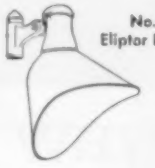
No. 9605
Fluorescent Luminaire

Lighting a race track

The Problem: To illuminate a race track for better visibility, and to provide especially high intensity lighting for dramatic effect at the finish line.

The Answer: Revere Eliptor Floodlights mounted on Revere Hinged Poles No. 199-D-30 were installed along the track. In the grandstand area, floodlights were aimed toward the finish line to heighten the intensity. Revere No. 2000 Series long range floodlights were mounted on the grandstand roof to further illuminate this area.

No. 2000 Series
Floodlight

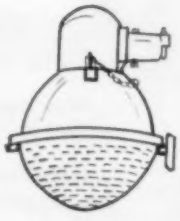


No. 3803
Eliptor Floodlight

Lighting a restricted area

The Problem: To illuminate a roadway encircling a restricted area at the Shippingport, Pa. Atomic Energy Generating Plant for both visibility and security.

The Answer: Revere Star-Lux Luminaires were installed around the entire perimeter of the restricted area, lighting the roadway and a 45° sloping embankment adjacent to it. Star-Lux Luminaires use up to 10,000 lumen incandescent lamps or 250 to 400-watt mercury lamps to provide any of the five A.S.A.-I.E.S. light distribution patterns.



No. 2311-A/2363
Star-Lux Luminaire

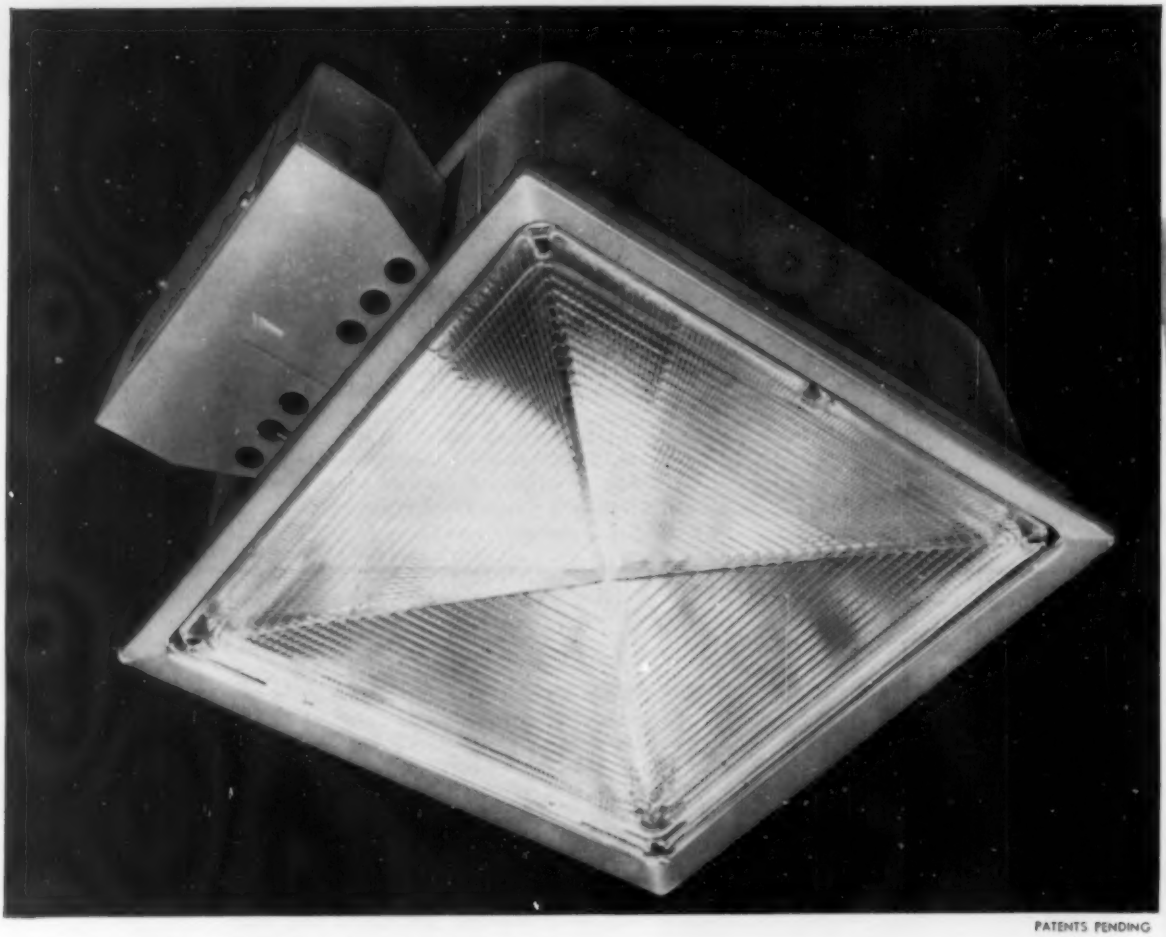
Write for Revere's complete catalog of outdoor lighting equipment

Revere ELECTRIC MFG. CO.

OUTDOOR LIGHTING

Revere Electric Mfg. Co. • 7420 Lehigh Ave. • Chicago 48, Ill. • SPring 4-1200

Available in Canada thru Curtis Lighting, Ltd., Leaside, Toronto, Ontario



PATENTS PENDING

NEW DAY-BRITE

UNI-FRAME

fits every lens box application...beautifully!

New THINcandescent design! Single, narrow, tapered frame fits flush with plaster or acoustical tile for happy blending of light and ceiling. No plaster frame needed.

New modular light pattern! Prismatically-accurate Pyrex* lens is largest available for 12″ lens box. Equalizes light distribution over square area. No light leaks.

New flexibility! One box size, in two look-alike series, accommodates any medium-base lamp (100-300 watts). Choice of three finishes: white enamel, aluminum or brass.

For additional information about UNI-FRAME, call your Day-Brite representative listed in the Yellow Pages. Or write . . .

Day-Brite Lighting, Inc., 6258 N. Broadway, St. Louis 15, Mo.
Day-Brite Lighting, Inc., of Calif., 530 Martin Ave., Santa Clara, Calif.

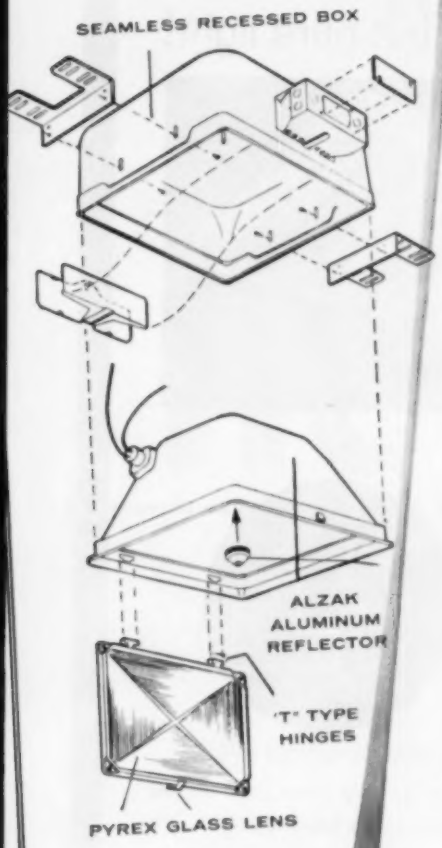
DECIDEDLY BETTER
DAY-BRITE
LIGHTING FIXTURES

*Registered trade name of Corning Glass Works

Z-263 © Day-Brite Lighting, Inc. 1958

NATION'S LARGEST MANUFACTURER OF COMMERCIAL AND INDUSTRIAL LIGHTING EQUIPMENT

was never shown. Monet had to leave it with the innkeeper as guaranty against his unpaid bill. He recovered it, found it largely ruined by cellar dampness, and cut it into strips.



ENGINEERING NEWS LETTER

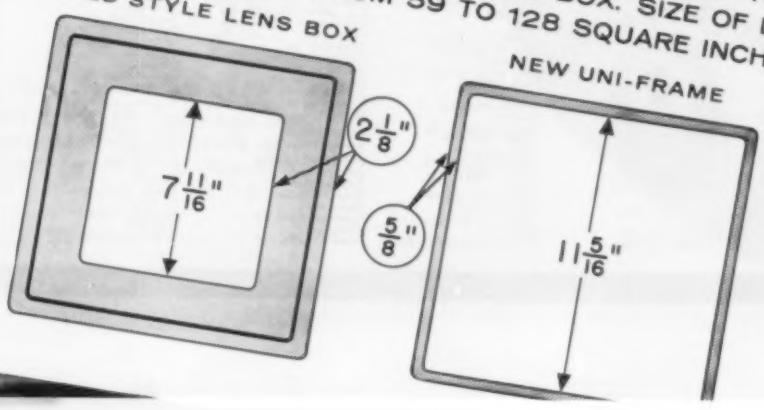
BAY-BRITE

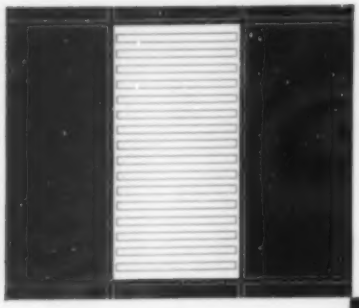
CHECK THESE UNI-FRAME FEATURES AGAINST ANY OTHER LENS BOX...

- √ Sculptured one-piece frame . . . first concealed hinged lens frame!
- √ A modular lens box . . . replaces 12" acoustical ceiling tile. For plaster ceilings, too.
- √ No light leaks! Lens is set like a jewel in hidden inner frame, held by stainless steel clips.
- √ Prismatic lens projects square (not elliptical) light pattern. No illumination drop-off in corners!
- √ Pyrex lens is standard . . . no extra charge.
- √ One-piece drawn aluminum Alzak reflector and angle lamp mounting for increased lighting efficiency.
- √ For commercial and residential use. Aluminum frames can be used outdoors.
- √ Snap-type latch and separable hinges speed installation and maintenance.
- √ Check the price advantage when you standardize on UNI-FRAME. One box size does it . . . throughout the job.

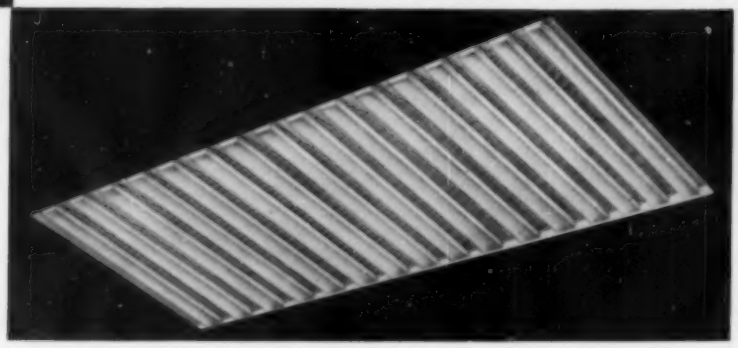
LUMINOUS AREA MORE THAN DOUBLED!

UNIQUE, NEW FRAME IS LESS THAN ONE-THIRD THE WIDTH OF FRAME ON OLD STYLE LENS BOX. SIZE OF LENS IS INCREASED FROM 59 TO 128 SQUARE INCHES!

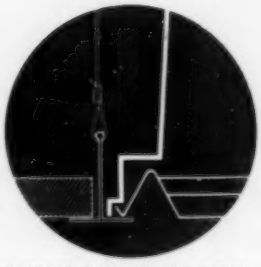




nothing but pure light!



Sometimes the difference in construction between various troffers is not readily apparent. But the difference in appearance after installation is always seen. Lightolier's new 2' x 4' modular troffers provide a clean panel of light that fills the entire opening between the structural members of suspended ceilings. No bulky steel frames, no exposed screws. Carefully engineered details like neat-fitting joints, frameless diffusers and hidden hinges make the decisive difference. Lightolier's Strialux, Domex and Optiplex diffusers meet most design or budget requirements. For a 120 PAGE CATALOG-BINDER detailing Lightolier's wide range of architectural lighting, write Dept. IE-98



EXPOSED GRID CEILING DETAIL

LIGHTOLIER

ARCHITECTURAL LIGHTING • RESIDENTIAL FIXTURES • PORTABLE LAMPS

MAIN OFFICE AND FACTORY: JERSEY CITY 5, NEW JERSEY

See all the newest Lightolier designs at these authorized distributors:

ALABAMA
Birmingham: Mayer Elec. Sup. Co.

ARIZONA
Phoenix: Brown Wholesale Elec.

CALIFORNIA
San Francisco: California Elec. Sup. Co.

COLORADO
Denver: Central Elec. Sup.

CONNECTICUT
Bridgeport: D. M. Tower
Hartford: Beacon Light & Sup. Co.
New Haven: Grand Light & Sup. Co.
New London: United Elec. Sup. Co.
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DISTRICT OF COLUMBIA
Maurice Elec. Sup. Co.
National Elec. Wholesalers
O. B. Evans & Bros.

FLORIDA
Miami: Farrey's Whsle. Hdwe. Co.

GEORGIA
Atlanta: Atlanta Ltg. Fix.
Noland Co.

ILLINOIS
Chicago: Efengee Elec. Sup. Co.
Englewood Elec. Sup. Co.
Hawkins Electric
Hyland Elec. Sup. Co.
Wholesale Elec. Sup.
Elgin: Fox Elec. Sup.
Rockford: Englewood Elec. Sup. Co.
Springfield: Springfield Elec. Sup.

INDIANA
Ft. Wayne: Mossman-Yarnelle Co.
Gary: Englewood Elec. Sup. Co.
So. Bend: Englewood Elec. Sup. Co.

IOWA
Des Moines: Weston Lighting Co.

KANSAS
Kansas City: W. T. Foley Elec. Co.

KENTUCKY
Paducah: Ohio Valley Sup.

LOUISIANA
Baton Rouge: Electrical Wholesalers
New Orleans: Interstate Elec. Co.

MAINE
Bangor: Standard Elec. Co
Portland: Holmes Elec. Supply Co.

MARYLAND
Baltimore: Excello Public Serv. Corp

MASSACHUSETTS
Boston: Mass. Gas & Elec. Light Co.
Henry L. Wolfers Inc.
Fitchburg: Service Elec. Sup. Co.
Pittsfield: Carr Supply
Springfield: Eastern Elec. Sup.
Worcester: Atlantic Elec. Sup.
Benjamin Elec. Sup.

MICHIGAN
Detroit: Madison Elec. Co.
Michigan Chandelier Co.
Flint: Royalite Co.
Grand Rapids: Purchase Elec. Sup. Co.
Pontiac: Standard Elec. Co.
Saginaw: Standard Elec.

MINNESOTA
Duluth: Northern Elec. Sup. Co.
Minneapolis: Charles A. Anderson & Co.
Northland Elec. Sup. Co.
St. Paul: Lax Elec. Co.

MISSOURI
St. Louis: M. K. Clark

NEBRASKA
Omaha: Electric Fix. & Sup. Co.

NEVADA
Reno: Western Elec. Distr. Co.

NEW HAMPSHIRE
Portsmouth: Mass. Gas & Elec. Light Co.

NEW JERSEY
Atlantic City: Franklin Elec. Sup. Co.
Camden: Camden Elec. Fix. Co.

NEW MEXICO
Albuquerque: Albuquerque Dist. Co.

NEW YORK
Albany: Havens Elec. Co. Inc
Binghamton: Frejo Elec. Sup. Co.
Buffalo: Buffalo Incan. Light Co. Inc.
Niagara Falls: Wyon Sup. Co.
Poughkeepsie: Electra Sup. Co.
Rochester: Rowe Electric Sup. Co.
Syracuse: Superior Elec.

NORTH CAROLINA
Charlotte: Independent Elec. Sup.
Durham: Noland Co.
Greensboro: Elec. Sup. & Equip. Co.
Kinston: Kinston Elec.
Winston-Salem: Noland Co.

OHIO
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Canton: The Electric Sales
Cincinnati: B. & B. Elec.
F. D. Lawrence Electric Co.
Cleveland: H. Loff Electric
Columbus: Elgee Elec. Co.
The Loob Elec. Co.
Dayton: Duellman Elec. Co.
Toledo: Gross Elec.
Youngstown: Mart Industries

OKLAHOMA
Tulsa: Lawson Elec. Co.

PENNSYLVANIA
Allentown: Coleman Elec. Co.
Erie: Kraus Elec. Co.
Harrisburg: Fluorescent Sup. Co.
Hazleton: Power Elec. Co. Inc.
New Castle: Midwestern Elec. Co.
Philadelphia: Ace Lighting Fix. Co.
Gold Seal Elec. Sup. Co.
Sylvan Elec. Fix. Co.
Pittsburgh: Allied Elec. Sup. Co.
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Wilkes-Barre: Anthracite Elec. Sup. Co.

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Providence: Leavitt Colson Co.

SOUTH CAROLINA
Anderson: Sullivan Hdwe. Co.
Columbia: Capitol Elec. Sup. Co.
Noland Co.
Greenville: Sullivan Hdwe. Co.

SOUTH DAKOTA
Watertown: J. H. Larson Elec. Co.

TENNESSEE
Johnson City: Noland Co
Nashville: Nashville Elec. Sup. Co.

TEXAS
Dallas: Rogers Elec. Sup.
Ft. Worth: Anderson Fixture Co.
Houston: Martin Associates
San Antonio: Southern Equip. Co.

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Lynchburg: Mid State Elec. Sup. Inc.
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mastermind
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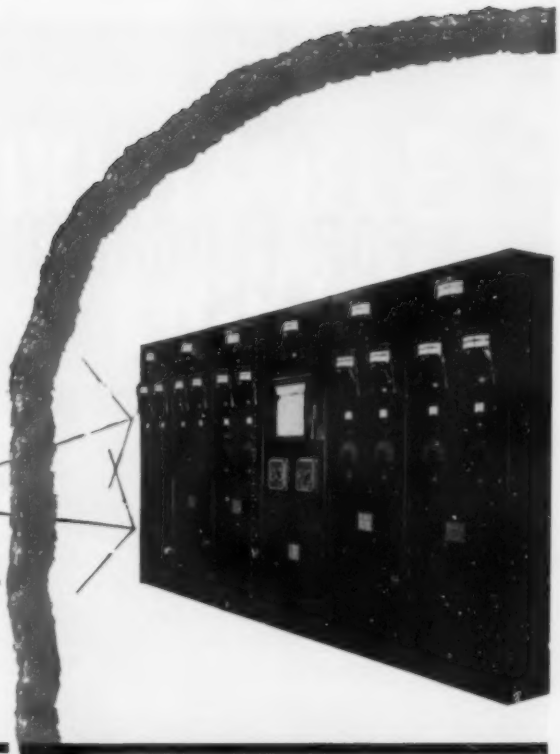

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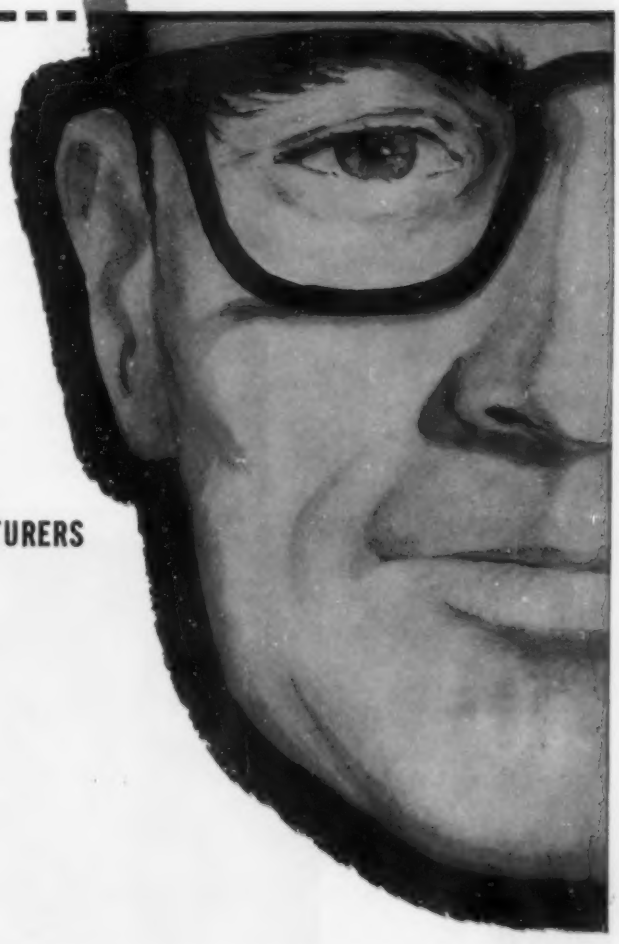

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SPECIALLY DESIGNED HUBBARD BRACKETS ANSWER ALL THE REQUIREMENTS FOR FLUORESCENT LUMINAIRES

Supporting the weight of a heavier fixture is only one of three important requirements for fluorescent luminaire brackets. The design must also be able to withstand 100 mile per hour wind velocities applied over a larger projected luminaire area as well as support the added seasonal weight of an increased snow- and ice-loading area.

Not content with laboratory tests alone to indicate the importance of "weather factors," Hubbard and Company made field installations to subject various designs to actual service conditions. One of the early observations made during this testing was the conclusion that "heavied-up" models of brackets designed for mercury vapor and filament type fixtures do not make satisfactory supports for fluorescent luminaires. As a result of this testing, an entirely new line of Hubbard galvanized steel Street Lighting Brackets has been developed especially for fluorescent installations.

Write us for more information on the two designs shown, as well as a description of other styles available.

HUBBARD AND COMPANY

Pittsburgh 1, Pa. • Chicago, Ill. • Oakland, Calif. • Plano, Texas

"Dancing in the wind" has been eliminated by angle steel "tie rods" and specially designed bracing in new Hubbard designs. (Below) Stock No. 23032, for use with luminaires with a maximum projected area not to exceed 8 square feet. Extension from pole—4 feet. Rise—14 inches.

(Above) Stock No. 23908, for use with luminaires with a maximum projected area not to exceed 8 square feet. Extension from pole—approximately 8 feet. Sizes to 20 feet.

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LIGHT OF THE WEST

With this array of NEW All-Brite products, added to the wide range of famous All-Brite lighting tools, YOU are the master of any lighting problem. Depend on All-Brite superior design, research and engineering for fullest control of commercial, industrial and institutional illumination.

All these are NEW, plus a full NEW line of hanging accessories. Ask for details.

write for catalogs and name of your local All-Brite representative

FLUORESCENT FIXTURES OF CALIFORNIA

352 SHAW ROAD
SOUTH SAN FRANCISCO, CALIF.

PLANTS ALSO IN LOS ANGELES; PORTLAND, OREGON; AND VANCOUVER, B. C., CANADA

G-E ballast design opens new horizons

"C" RATING

"D" RATING

"E" RATING

New G-E ballast brings "C" sound rating to 800 MA applications

new General Electric 6G1140 ballast is two sound ratings quieter than any "E" rated ballast for two 96T12/HO rapid-start lamps

The demands of lighting progress have again been answered by ***the leader*** in the ballast industry. General Electric engineers have effected reductions in size, operating temperature, weight, and sound level in designing the new 6G1140 ballast. The new 6G1140 is two sound ratings quieter than any "E" rated high-output rapid-start ballast on the market, and operates at less than 90 C in a two-lamp, eight-foot, louvered commercial fixture, surface mounted against an acoustic tile ceiling. This latest development in ballast progress is the result of two specialized General Electric facilities:

In General Electric's modern sound testing laboratory, engineers perform actual sound tests in an anechoic chamber designed and developed by G-E engineers exclusively for ballast testing. General Electric's investment in laboratory equipment has led to a complete ballast sound rating system that has been adopted by the ballast industry. The copyrighted G-E Ballast Sound Rating Calculator helps you select the proper rating to satisfy the sound requirements of every installation.

G.E.'s fixture test laboratory is believed to be the only one of its kind in the ballast industry. Lamps, fixtures, and ballasts are tested together in a controlled, draft-free ambient of 25 C, without heat dissipating devices. Thermal measurements are taken only after the ballast has reached a stable operating temperature. G-E heat measurements reflect actual, modern operating conditions. You get lamp-matched ballasts from General Electric.

Actual sound tests, performed in General Electric's anechoic chamber, help G-E engineers develop lamp-matched ballasts to answer the needs and demands of lighting progress.

Each fluorescent lighting application is accepted as a separate challenge by General Electric engineers who know there is no one ballast that will act as a solution for all lighting problems. The new 6G1140 ballast is another example of General Electric leadership in ballast progress . . . another example of General Electric's OPERATION UPTURN . . . extra value for your ballast dollar. *Section 401-69, General Electric Company, Schenectady 5, N. Y.*

1958 GENERAL ELECTRIC BALLAST PROGRESS		
NEW 6G1020 operates at LESS THAN 90 C in four-lamp 40-watt T12 fixtures	NEW 6G1140 brings "C" SOUND RATING to two-lamp 96T12/HO-RS applications	WATCH FOR NEW BALLAST PROGRESS FROM GENERAL ELECTRIC . . . the leader in the ballast industry

OPERATION upturn — Buy now for extra values — GENERAL ELECTRIC

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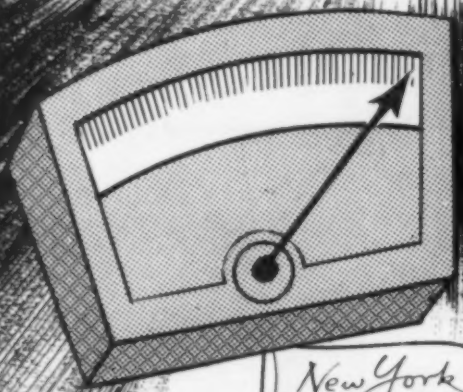
GENERAL ELECTRIC

Brightest Idea *in the Lighting Industry*

2ND NATIONAL LIGHTING EXPOSITION

offers Manufacturers Unequalled Marketing Opportunities



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So says electrical contractor, Mr. John Lockshaw of Downey Electric Co., Downey, California about a recent installation of the Sunbeam SIGHTLINE® system. He further states, "We believe that the following are the reasons why this lighting job went up so fast and neatly: The fixtures are completely assembled, prewired and ready for connecting circuit leads. The hangers just thread into the swivel sockets. It takes but a twist of the wrist to clamp the system to the mounting plates on the ceiling. The spring-loaded bottom swivels and perfectly balanced fixtures eliminate on-the-job leveling problems. Continuous rows are quickly achieved by interlocking units on sturdy support channels. Fine vertical adjustments can be made *after* fixtures are hung by turning finger-controlled "hex" nuts.
It also amazed us to see these Sunbeam SIGHTLINE® units go up with so little need for tools."

Because SIGHTLINE® is a truly integrated, totally indirect lighting system which produces wide spread illumination with absolutely no glare, direct or reflected, it is being specified more and more for interiors where the utmost visual comfort is required.

SUNBEAM visionaire LIGHTING CONCEPTS

Sunbeam Lighting Company, 777 East 14th Pl., Los Angeles 21, California & Gary, Indiana

An unlighted field **Costs Money...**

A lighted field **EARNS Money**

A sports administrator cannot afford to rely only on The Big Games to make his year's program profitable.

He must go after the bread-and-butter business too: The early and mid-season contests which – when played at night – will attract more customers who "just like to see a good ball game."

When Crouse-Hinds lights the play, there's daytime comfort of viewing for *everyone* – spectators, officials, players and coaches. No squinting from lack of illumination. No squinting because of glare.

Better play, longer practice time, increased school spirit, better attendance . . . these are just a few of the dividends possible with Crouse-Hinds sports floodlighting.

Name the spectator sport . . . name the participator sport: Crouse-Hinds provides durable, high-efficiency floodlighting for all.

Let one of our Lighting Engineers help plan your installations. Just send a map of your stadium, field, court or pool . . . or write us to send a field engineer to your office for consultation. He will show you how better floodlighting *pays its own way!*

Type FLA Sportslight

Meantime, send for our 76-page illustrated Bulletin 2605, "Night Time Is Play Time," describing Crouse-Hinds sports-lighting layouts for 45 indoor and outdoor sports.

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How luminous ceilings

wake up a room in three easy steps

Here are the basic steps in installing a luminous ceiling made with BAKELITE Rigid Vinyl Sheets. Look at the change! Glare and sharply contrasting shadows are gone. The whole room is bathed in even, eye-saving light.

BAKELITE Brand Rigid Vinyl Sheets weigh so little that they are easily installed and maintained. They resist discoloration. They conceal ducts and sprinklers, but soften and fall below sprinkler operating temperatures.

Improve the lighting and appearance of any room—any size—with luminous ceilings made of BAKELITE Brand Rigid Vinyl Sheets. Write Dept. IN-25K for more facts, Bakelite Company, Division of Union Carbide Corporation, 30 East 42nd Street, New York 17, N. Y.

It pays to design with **BAKELITE** BRAND **PLASTICS**

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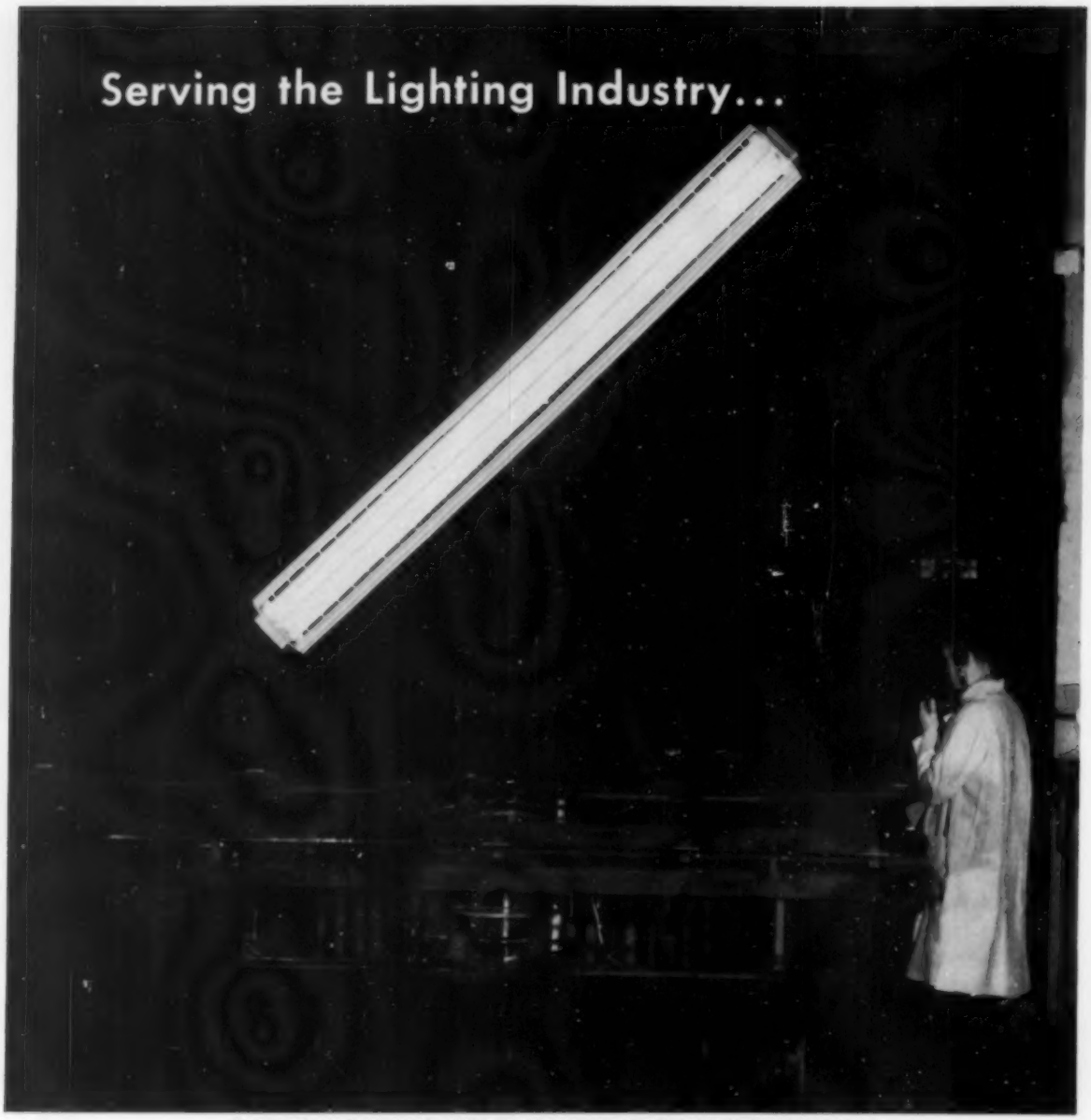

Testing a large fluorescent luminaire on an automatic recording distribution photometer.

. . . In 60 years of specialization in the field of laboratory service to the Lighting Industry, ETL has developed many skills and many specialized items of test equipment for the efficient and accurate evaluation of light sources, luminaires, lighting materials and accessories.

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New manufacturers' catalogs and bulletins listed below are available free to readers of ILLUMINATING ENGINEERING by mailing the coupon. Circle the numbers of those items which you want, drop in envelope or fasten securely to back of 3-cent postcard addressed to Publications Office.

(1) OUTDOOR LIGHT CONTROL Bulletin PA 569, four pages in two colors, describes Photoswitch Light Control, new automatic on-off control for lighting systems keyed to outdoor light conditions. Folder gives details of applications, construction and operation features, and specifications. Photoswitch Division, Electronics Corp. of Amerien, Cambridge, Mass.

(2) SURGICAL LIGHT Flyer describes new Castle #8 M-P surgical light for ceiling or wall mounting or floor model to be used as supplementary examination lighting in doctors' offices. Folder gives complete details on special features; illustrates luminaire in use. Wilmot-Castle Co., Rochester, N. Y.

(3) HIGHWAY POLES 24-page folder LS-23 "Monotube Poles for Highway Lighting and Signing" shows various highway pole designs, in both steel and aluminum, giving full details as to mounting arrangements, base and bracket details, specifications, and includes typical installation photos; completely illustrated and cataloged. The Union Metal Mfg. Co., Canton, Ohio.

(4) HANDBOOK OF LIGHTING CONTROL Comprehensive 16-page booklet gives specifications and illustrative schedules for lighting control systems in theaters and auditoriums; complete details on required equipment, electrical ranges, dimmers, patch panels, etc. Lumitron Div., Metropolitan Electric Mfg. Co., Long Island City, N. Y.

(5) FIXTURE HANGER Snapee catalog sheet describes new movable patented device for hanging luminaires, boxes, or other equipment on tee-bar, requiring no tool or hole drilling. Daniel Woodhead Co., Chicago, Ill.

(6) PACKAGED LUMINOUS CEILING. Two-color folder No. 83V illustrates and describes new Sunshine Ceiling 6' x 4' incandescent lighting unit designed for use in standard bathrooms and smaller kitchens; said to be easily installed, uses six 100-watt incandescent lamps. John C. Virden Co., Cleveland, Ohio.

(7) SHALLOW LUMINAIRES are described in eight-page, two-color Bulletin 582-L which gives full details of company's new 60th Anniversary Series of commercial fluorescent luminaires 3½" in depth with wide selection as to number of lamps and widths, choice of sides and bottoms; furnishes photometric and installation data. Garey Lighting, Chicago, Ill.

(8) PHOTO ELECTRIC CONTROL Bulletin 48 covers description, specifications, installation and operating details of Utilities Photo Control for use in individual multiple systems. Precision Magnetic Controls, Ridgewood, N. J.

(9) SERVICE STATION LIGHTING. Completely illustrated and detailed 24-page two-color Bulletin 2704 includes listings of conduletes and floodlights together with recommendations for electrical installations and planning wiring and lighting for service stations. Crouse-Hinds Co., Syracuse, N. Y.

(Continued on page 44A)

Offer good for two months only

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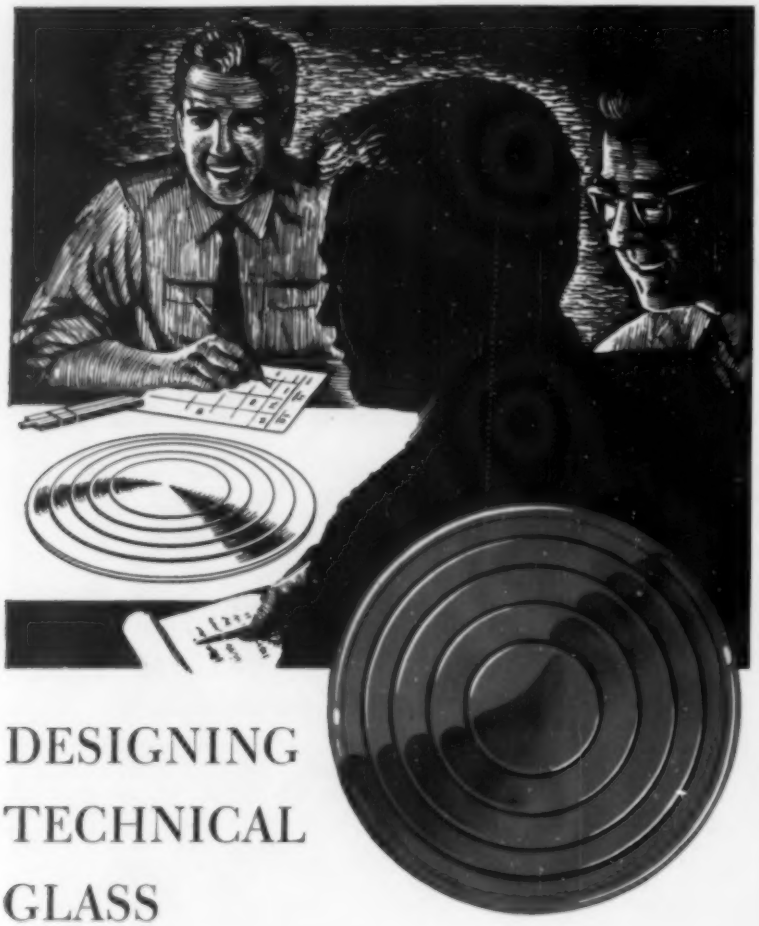

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Whatever your needs in technical glass components—Kopp Glass has the engineering staff, modern laboratories and manufacturing facilities to meet them. If you require parts with certain light and color transmission, beam control, thermal shock resistance, mechanical strength, dimensional uniformity or other properties—Kopp technicians can supply them to your exact specifications.

To meet specific application requirements, Kopp engineers develop a formula of the actual ingredients to provide the finished part with the desired properties . . . design the mold in which molten glass is pressed to exact physical dimension . . . and establish rigidly-controlled manufacturing procedures.

What's your problem? Perhaps we could design a part for you in glass that would solve a problem or improve your product. If you are interested, we'll be glad to discuss it with you.

Ask for Bulletin 553-A on Kopp Engineered Glass.

KOPP GLASS SPECIALISTS IN TECHNICAL GLASS

THE GLASS

Kopp Glass INC.

SWISSVALE, PENNSYLVANIA

(Continued from page 22A)

Affairs. This new service will include presentation of lectures and demonstrations for technical and editorial audiences concerning glass and ceramics. Mr. McLellan, who has been with Corning since 1940, was formerly staff engineer.

Frank E. Stech has been named manager of product engineering and quality control by the Phoenix Glass Co., Monaca, Pa. For ten years prior to this appointment, Mr. Stech was in charge of Quality Process Engineering for the Corning Glass Co.

Weston Instruments Division of Daystrom Inc. has announced the appointment of **John C. Washington** as manager of the Los Angeles district. In his new position, Mr. Washington will supervise all sales and district office operations in Southern California and parts of Nevada.

George A. Nagel, Chester, Conn. has announced his retirement from the position of Associate Highway Engineer with the Connecticut State Highway Department as of Sept. 1. He plans to continue in the field of roadway and emergency lighting as an independent consultant.

Pyle-National Co. of Chicago has contracted to acquire the Steber Manufacturing Co., Broadview, Ill., according to a recent announcement by **William C. Croft,** president of Pyle-National and **Clarence L. Steber.** Steber Manufacturing will continue its operations as a division of the Pyle-National Co. with Mr. Steber remaining as president.

Dr. Martin J. Kelly, president of Bell Telephone Laboratories will be the 1959 recipient of the John Fritz Medal for "his achievements in electronics, leadership of a great industrial research laboratory and contributions to the defense of the country through science and technology. The Medal is sponsored jointly by the American Society of Civil Engineers, American Institute of Mining, Metallurgical and Petroleum Engineers, American Society of Mechanical Engineers and the American Institute of Electrical Engineers.

Vice Admiral **George F. Hussey, Jr.,** USN (Ret.), managing director of the American Standards Association, has been elected vice-president of the International Organization for Standardization at the 1958 triennial meeting of that body in Harrogate, England. Forty nations are now members of the International Organization for Standardization.

(Continued on page 40A)

48-250 open reflector downlight uses inexpensive general service type lamps up to 300 watts. Most often specified for department stores, banks and public lobbies.

Architect: Office of Alfred Easton Poor/Consulting Engineer: Edward E. Hughes/Electrical Contractor: Charles P. Zweifel/Electrical Supplier: Westinghouse Electric Supply Co.

Chemical Corn Exchange Bank, New York

48-500 high ceiling ellipsoidal open reflector downlight for auditoriums, churches, museums. Available with Alzak natural or golden reflector in 300, 500, 750 and 1,000 watt sizes.

48-1220 for gymnasiums and lunchrooms, playrooms and arenas. Spoke guard is of solid cast aluminum, heat-treated for strength. Available for surface, recessed, pendant or I-beam installations. Wattages up to 1,000 . . . also in mercury vapor series.

This photographic report taken by the Committee on Lighting of the Central Station Properties, Illuminating Engineering Society in October 1954 visually proves the importance of properly ventilated lamp husks.

Dirty	Improvement	Cleanest
No. 1 Test	No. 2 Test	No. 3 Test
No vents	Vents poorly located	Vents properly located

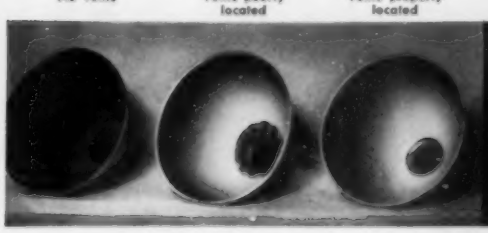
downlights by mc Philben

cooler burning
lower maintenance costs
tested and proved

mcPhilben's 48 series interior downlights were selected to light the main area of the Chemical Corn Exchange Bank in New York in 1957. Today, after more than a year of operation, maintenance engineers report an operating efficiency and lamplife unequalled by any other downlight in use.

All mcPhilben interior downlight units are equipped with cast aluminum radiators and cooling fins. This outstanding engineering feature assures cooler burning and longer lamplife. In addition, reflectors remain cleaner and brighter for longer . . . as proved in the I.E.S. test shown below.

Full details on these downlights are now available on individual specification data sheets. Ask your mcPhilben representative for your copies or write to mcPhilben. Ask for the 48 and 84 lines.



mc Philben
LIGHTING COMPANY
1329 WILLOUGHBY AVENUE, BROOKLYN 27, NEW YORK

low cost light

thanks to **CHAMPION**

LIGHTMANSHIP

NEW MAINTENANCE MANUAL— another example of Champion LIGHTmanship, an attitude and aptitude that makes sure you get all the light you pay for. Many useful, cost-saving hints have been added in this new edition of the popular guide that has proved to be of great practical value to lighting men everywhere. Copies available on your letterhead request.

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CHAMPION Lamps

Incandescent Fluorescent

Your best buy in lamps

CHAMPION LAMP WORKS
Lynn, Massachusetts
A division of Consolidated Electric Lamp Co.

(*Continued from page 38A*)

James D. Hall has retired from the Westinghouse Lamp Division, Bloomfield, N. J. after more than 38 years of service. At the time of his retirement, he was staff asisstant to the manager of the Large Lamp Department, responsible for coordinating, simplifying and revising the listing of the many lamps manufactured by the Division. For many years, Mr. Hall was manager of large incandescent lamps.

Obituary

A. T. Nadeau, Southern California Section, died on July 28 at the age of 57. Mr. Nadeau was a member of the National Roadway Committee and Chairman of the subcommittee on Traffic Sign Lighting. He was Director of the Bureau of Street Lighting, City of Los Angeles and had been affiliated with the Bureau since 1926.

He held membership in the Los Angeles Electrical Club and was a Registered civil and electrical engineer.

Harold I. Strahn, Southern California Section died on July 18. He was 52. At the time of his death, Mr. Strahn was serving on the Board of Managers of his Section and was also Chairman of the Public Relations and Information Committee. For 21 years, he was associated with the Department of Water & Power, City of Los Angeles.

Mr. Strahn was the first prize winner in the South Pacific Coast Region's 1957 MMILJ Contest, and received honorable mention in the 1957 International Lighting Competition. In 1958, he won third prize in his Section's contest for My Most Interesting Lighting Job.

Deaths

Walter B. Morton, Eastern Pennsylvania Section.
Edmund C. Schorr, Chicago Section.

BOOKS AND PAMPHLETS

Buildings for Research, published by F. W. Dodge Corp., 119 West 40th St., New York, N. Y. 224 9x11½-inch pages, hard-bound, indexed. Price: $9.50.

The 44 new research buildings described in this book are owned by corporations, government agencies and uni-

(*Continued on page 43A*)

Now...a Nationwide Trend to

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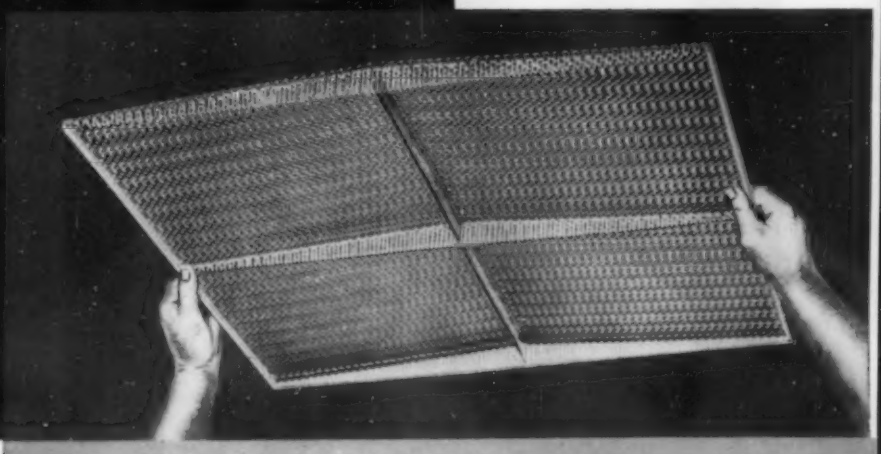

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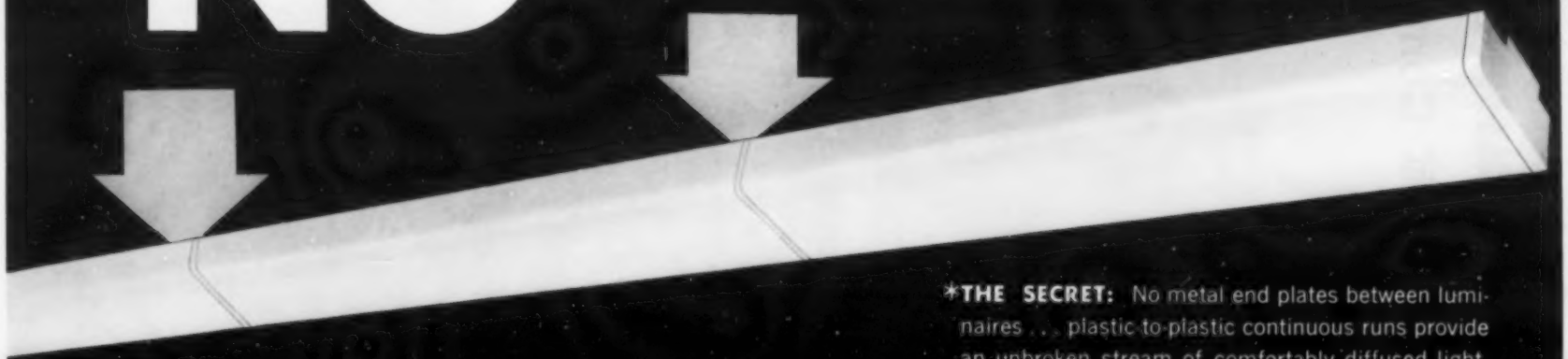

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(Continued from page 40A)

versities. They are used for nuclear research, industrial engineering, biological, electronic and chemical researches. In most cases the solution to problems other than lighting are stressed, although the lighting systems used are shown in the many photographs and in some cases described in the text.

The articles comprising this book are reprinted from *Architectural Record*. There are over 500 photographs, plans, drawings, charts and tables.

Seeing, A Guide to the Best Use and Care of the Eyes, published by The Western Institute of Light and Vision, 1304 Lexington Ave., Pasadena 6, Calif. Price: 100, $50; 500, $175; 1000, $250; 5000, $775.

This 32-page booklet was prepared as educational material for distribution by utilities to schools, service clubs, PTA groups, and commercial and industrial conferences. It contains basic information on eye care and lighting recommendations.

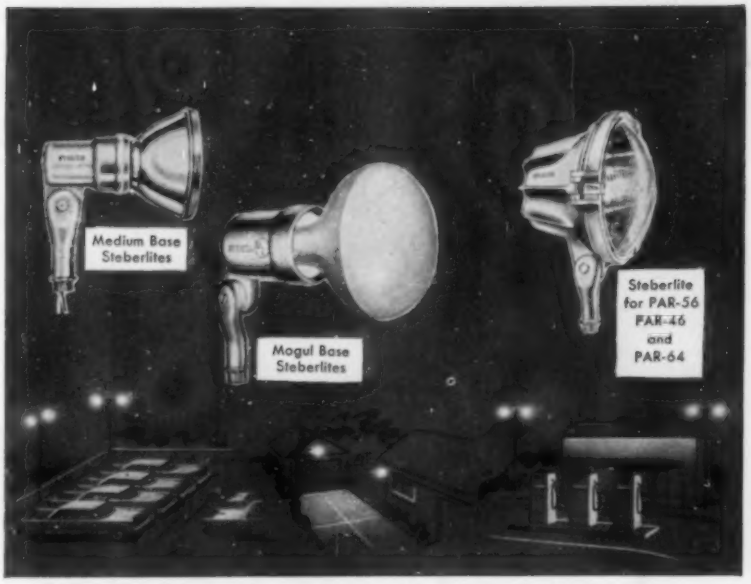
Preliminary Field Evaluation of a Naval Aircraft Running Light Configuration, by Douglas R. Cornog, George E. Rowland and Douglas Courtney. Prepared by Courtney and Co., 1711 Walnut St., Philadelphia 3, Pa.

This 92-page final report outlines the problems studied, development of an optimal exterior lighting system for naval aircraft, description of flight research, results of the research and conclusions. Future research and development planned are discussed. The work has been carried out jointly by the Navy Bureau of Aeronautics and Courtney and Co.

Residential Lighting Talk, available from local General Electric Large Lamp district offices. Printed talk with 36 full-color cardboard-mounted slides. Price, $12.

How to Develop and Present a Commercial Modernization Program, available from Commercial Department, Edison Electric Institute, 750 Third Ave., New York 17, N. Y. Price, $1.00 to members of EEI, 10 per cent additional to non-members and companies outside the United States.

Society of Plastics Engineers Prospectus, new 16-page brochure summarizing the activities and benefits of SPE. Copies are available, without charge, from the Society of Plastics Engineers, Inc., 34 East Putnam Ave., Greenwich, Conn.



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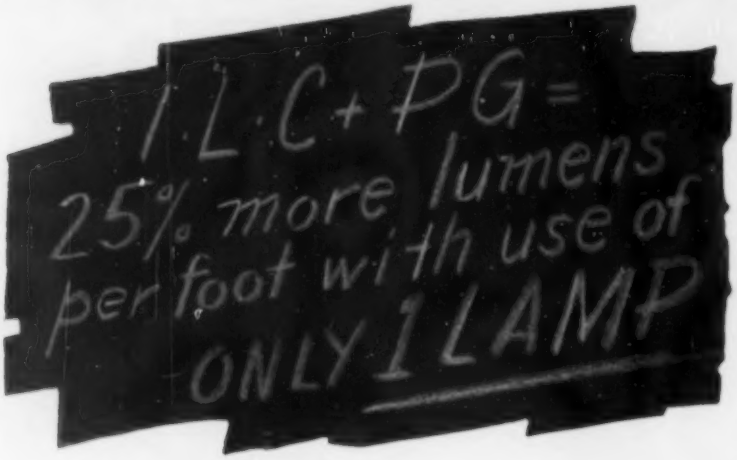

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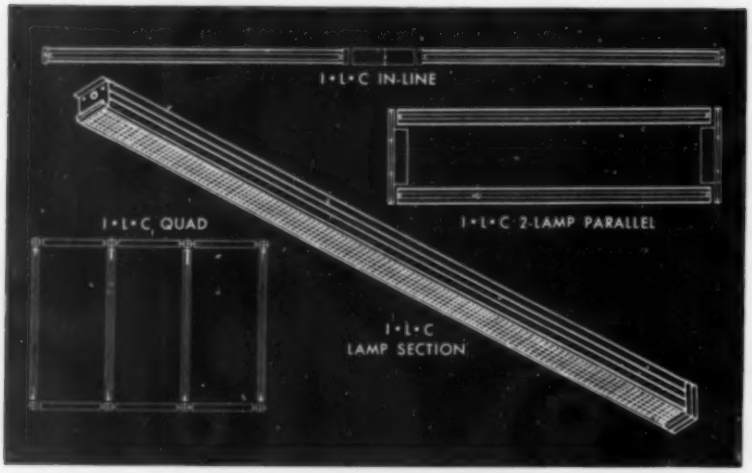

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For complete details send for Bulletin S257

581 A

SILVRAY LIGHTING, INC.
BOUND BROOK, NEW JERSEY

NEW EQUIPMENT DATA

(Continued from page 37A)

(10) LIGHTING MAINTENANCE MANUAL. New edition of this company's 50-page pocket size booklet covers in detail a program of proper lighting maintenance and efficiency through cleaning and replacement of various systems, types of lamps and their advantages in complete detail. Champion Lamp Works, Lynn, Mass.

(11) FIXTURE FASTENERS. Four-page folder Bulletin KF 526 describes Camloc captive fasteners for use in luminaire assembly and installation; folder describes various types of these fasteners, shows dimensions and assembly as well as prices. Camloc Fastener Corp., Paramus, N. J.

(12) RECESSED FLUORESCENT LUMINAIRES 16-page booklet in color entitled "Modular Lighting for Modular Measure" covers company's Mobilex and Troffer line of recessed fluorescent lighting; illustrates their relation to building cube and installation in various types of ceiling. Day-Brite Lighting Inc., St. Louis.

(13) STREET LIGHTING Bulletins SL 1 and SL 6 describe street lighting luminaires designated lines 1 and 3; provide complete descriptions, photometric data, catalog numbers; give application and ordering information. Line Material Industries, Milwaukee, Wis.

(14) DECORATIVE LUMINAIRES. Full-color "Portfolio of Decorative Lighting Fixtures" includes 40 pages showing 100 fixture designs both contemporary and traditional, especially prepared for architects, decorators, and others; gives complete description and precise dimensions. Lightolier, Inc., Jersey City, N. J.

(15) LUMINOUS CEILINGS. Completely illustrated brochure describes Thermotank Lumenated Ceiling lighting, includes before and after photographs, installations and specifications, and information as to air-conditioning and sprinkler systems. John J. Fannon & Co., Detroit, tems. John J. Fannon & Co., Detroit.

(16) RECESSED INCANDESCENT. Three-color, four-page catalog No. PR-1 shows new line of recessed incandescent fixtures featuring Preslock frame with various diffuser bottoms and describes special features for maintenance and installation. Prescolite, Barkeley, Calif.

(17) SERVICE STATION LUMINAIRE. Four-page folder on 9700 Series Fluorescent Island Lighter for service stations includes complete product information, specifications, accessory information and ordering data; shows construction details and types of brackets. Revere Electric Mfg. Co., Chicago, Ill.

(18) INDIRECT FLUORESCENT LUMINAIRES. Four-page, two-color folder describes three new types of company's ILC units for commercial installation using new high output fluorescent lamps in single, tandem, or in parallel and four-lamp arrangements; provides photometric and installation data. Silvray Lighting, Inc., Bound Brook, N. J.

(Continued on page 46A)

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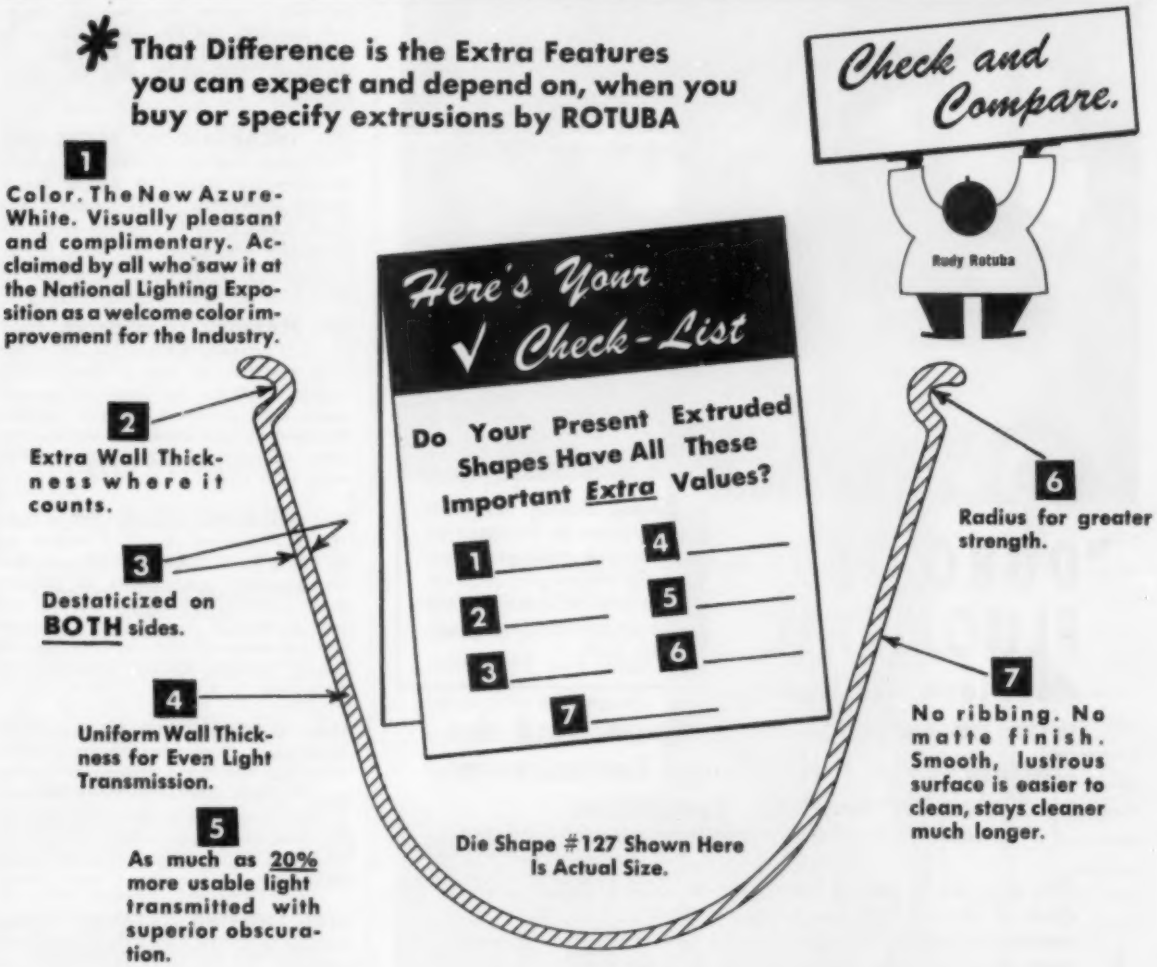
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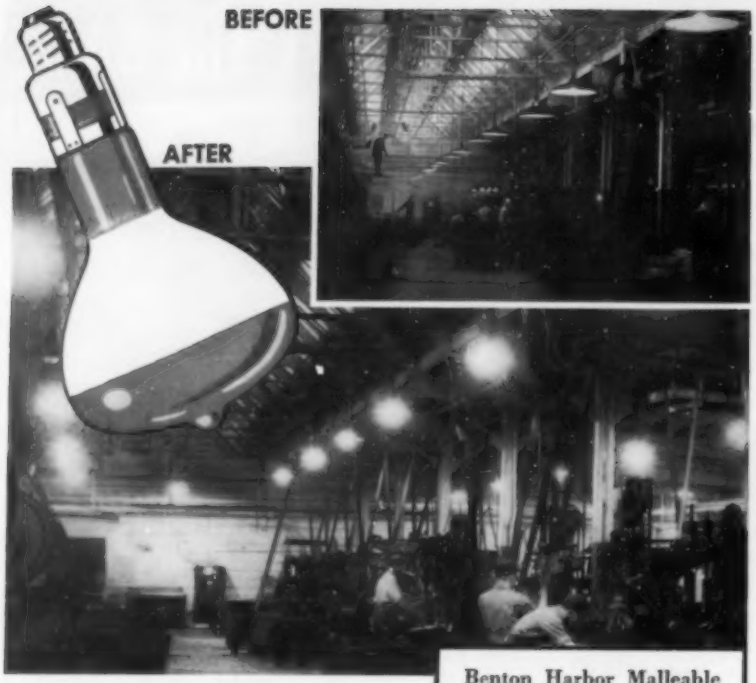

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NEW EQUIPMENT DATA

(Continued from page 44A)

(19) FLUORESCENT BALLASTS. 20-page Bulletin GEC-983L in two colors gives prices and data on 184 various type ballasts for fluorescent lamps, includes descriptive tables, cross section dimension diagrams and obsolescence chart as well as installation and operating instructions. General Electric Co., Schenectady, N. Y.

(20) INCANDESCENT REFLECTORS. Eight-page, two-color brouchure No. 1093 describes new Super-Lok line of incandescent reflectors, both company and RLM types, gives full details as to finishes and accessories including dimensions, types and catalog numbers. Steber Mfg. Co., Broadview, Ill.

(20) PLATFORM TELESCOPERS. Bulletin 55-D provides information on Models PUL and LB, as well as custom-built, lifting platforms for overhead maintenance, both motorized and not; suggests typical uses and illustrates various features. Economy Engineering Co., Chicago, Ill.

(21) REFLECTOR LAMPS. "More Light Where You Need It . . ." booklet describes general, flood, spot, display and supplementary applications of reflector lamps; provides chart of lamp size and type to meet fc requirements; compares relative costs of the various types of lamps. Sylvania Electric Products, Inc., New York, N. Y.

(22) FLUORESCENT LUMINAIR&S. Eight-page, three-color brochure covers Twin-Lux new 2 x 4 fluorescent lighting unit, various diffuser bottoms available in color; provides photometric information and gives application and installation data. Smoot-Holman Co., Inglewood, Calif.

(23) LIGHTING CATALOG. 32-page catalog in several colors shows company's complete line of incandescent and fluorescent luminaires for residential, commercial and industrial installation; illustrates each unit and gives details of construction and dimensions. Markstone Mfg. Co., Chicago, Ill.

(24) PROTECTIVE LIGHT. Eight-page, two-color folder shows Wide-Lite all-weather outdoor luminaire for critical areas which combines mercury vapor and incandescent lamps; folder gives construction details, information on operation and other data. Wide-Lite Corp., Houston, Texas.

(25) PACKAGED LIGHTING CONTROL. Bulletin 76P gives complete details on new lighting control Controlette for application in schools and other small auditoriums and public areas where simplified manual, interlocking control is practical; describes features; shows various combinations. Ward-Leonard Electric Co., Mt. Vernon, N. Y.

(26) COMMERCIAL FLUORESCENT. New Boston Series of company's fluorescent fixture line is described in catalog page; provides details on available lengths and combinations, bottoms and mounting data. Eastern Fixture Co., Boston, Mass.

(27) GLASS. 28-page booklet "Glass — to brighten your product's future" covers many types of glass; outlines various forming and finishing processes; illustrates some latest industrial and commercial uses for glass; describes characteristics. Lancaster Glass Corp., Lancaster, Ohio.

(28) FLUORESCENT LUMINAIRES. Complete catalog shows company's line of industrial and commercial fluorescent lighting fixtures, luminous ceilings, troffers, etc.; gives photometric and other illumination characteristics, as well as installation data. Leadlight Fixture Co., Oakland, Calif.

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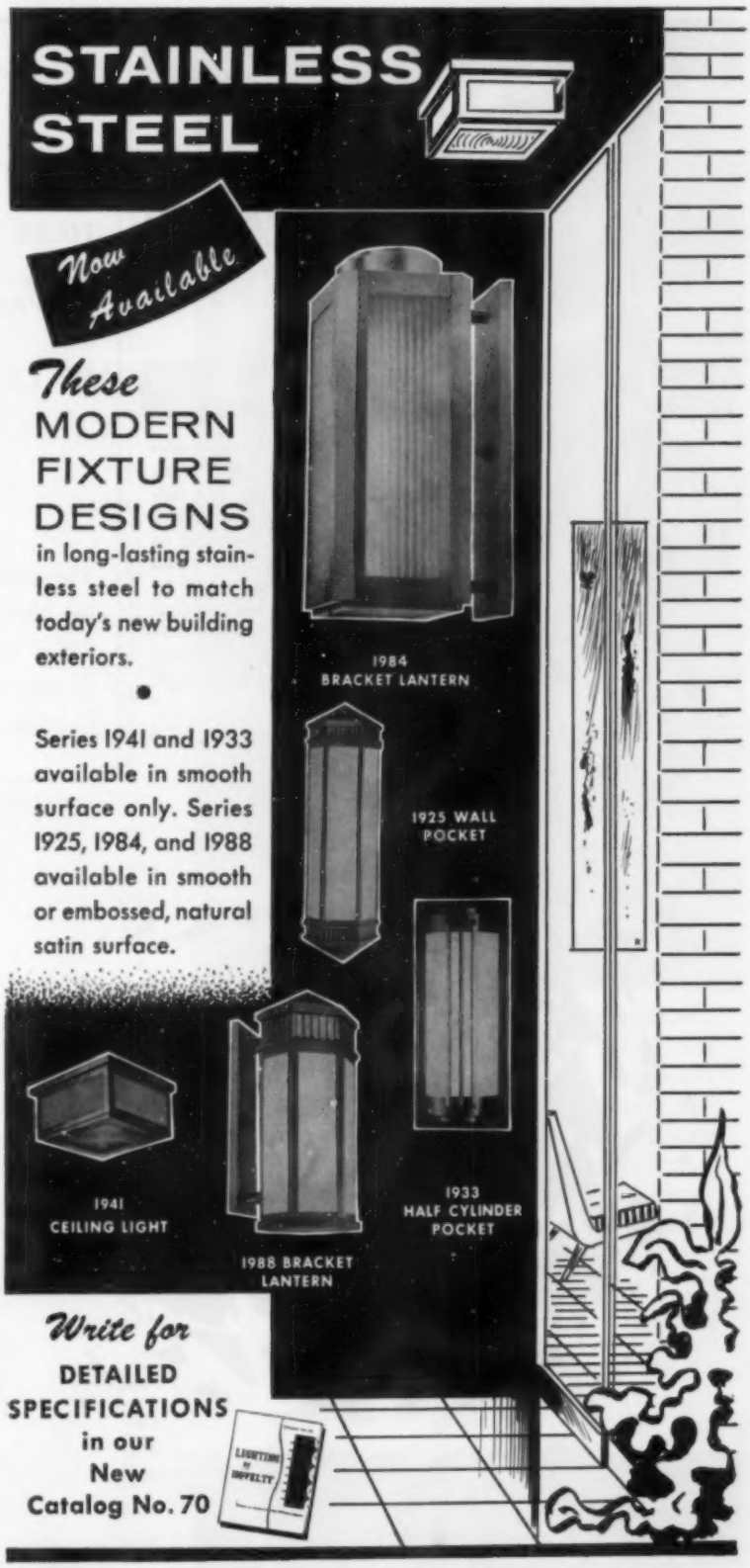
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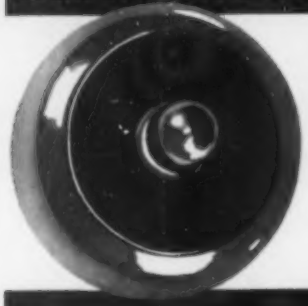

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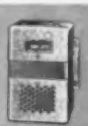
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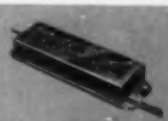
MERCURY LAMP TRANSFORMERS


FLUORESCENT LAMP BALLASTS

INSTALLATION COSTS LESS...

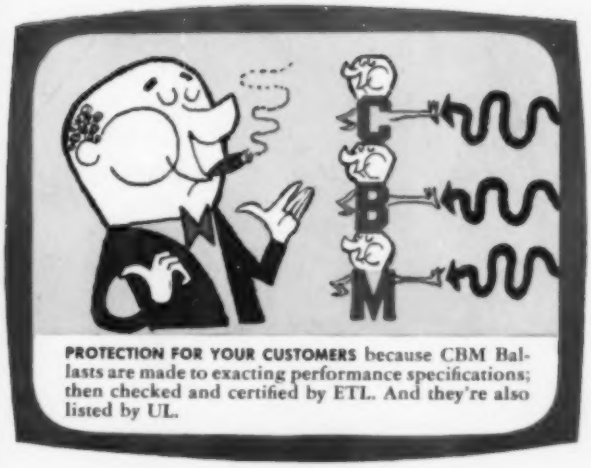
with fixtures using

Certified CBM Ballasts

KEEPS LABOR COSTS DOWN, TOO. (Low power factor can boost these costs as much as 65%.) CBM Ballasts mean fewer circuits, fewer man-hours needed.

SAVE ON WIRE COSTS—for High Power Factor in Certified CBM Ballasts saves your customers from expensive oversize wiring needed by low power factor equipment. Guards against penalty charges on light bills, too!

LONGER LIFE FOR CBM BALLASTS—because CBM specifications set a limit for temperature rise. This helps provide more efficient, longer, trouble-free service.



PROTECTION FOR YOUR CUSTOMERS because CBM Ballasts are made to exacting performance specifications; then checked and certified by ETL. And they're also listed by UL.

WRITE FOR CBM BOOKLET
"Why High Power Factor ballasts cut your lighting costs"

CERTIFIED BALLAST MANUFACTURERS

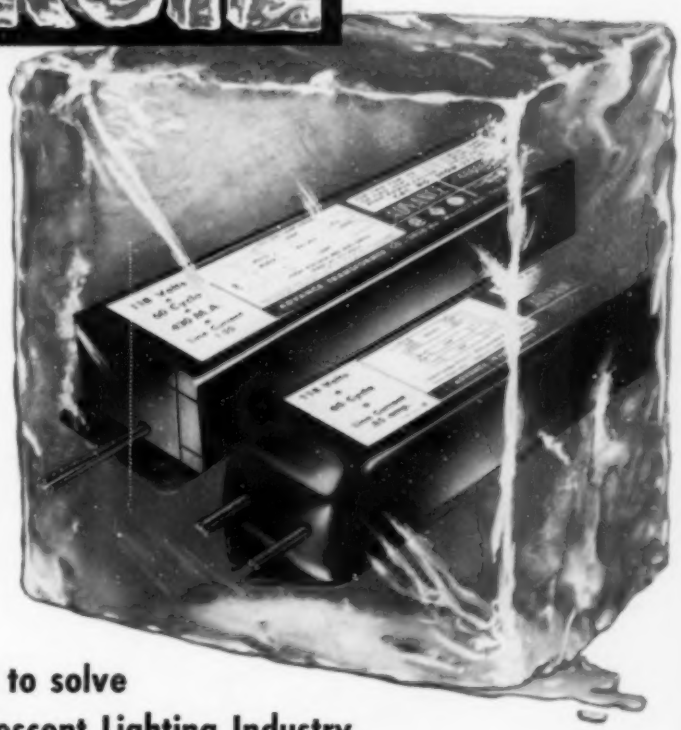
2116 KEITH BUILDING • CLEVELAND 15, OHIO

Participation in CBM is open to any manufacturer who wishes to qualify

CBM-4-E

ADVANCE KOOL KOIL

REVOLUTIONARY NEW FLUORESCENT LAMP BALLASTS FOR SLIMLINE AND RAPID START LAMPS



Here's what KOOL KOIL will do to solve the heat problems of the Fluorescent Lighting Industry

1 LOWER CONDENSER TEMPERATURE

Advance engineers recognized the fact that to end costly condenser trouble due to ballast overheating required both design and component changes. They designed the KOOL KOIL Rapid Start case to allow a greater separation of condenser and coil. They tested new grades of steel, wire, insulation and compounds and after three years developed Kool Koil, the only ballast under comparative tests that did not overheat to temperatures exceeding the capacitor manufacturer's 70° C warranty limit.

2 LOWER WATTAGE LOSS

The efficiency of KOOL KOIL Ballasts (as much as 20% less wattage loss) offers Fluorescent lighting users a saving in operating costs and the manufacturer an opportunity to increase the efficiency of its units. The higher efficiency of KOOL KOIL (up to 15% more light output) enables the user to achieve the same illumination levels with 7% fewer fixtures.

3 LOWER COIL TEMPERATURE

Under actual operating conditions in a surface-mounted, 4-lamp, fully enclosed unit the maximum coil temperature of KOOL KOIL Ballasts tested was 17° C cooler than Ballast "A" and 22° C lower than Ballast "B".

4 LOWER CASE TEMPERATURE

Operating in a 6-lamp recessed glass-bottom troffer, the ADVANCE Series-Sequence Ballast (RSH-2E75-S) case temperature was 18° C lower than Ballast "B" and 15° C lower than Ballast "A".

5 LONGER BALLAST LIFE

KOOL KOIL Ballasts practically eliminate ballast replacement. For every 10° C increase in case temperature over the maximum 90° C U/L limit, ballast life is cut in half. By operating with case temperatures 15 to 20 degrees cooler than ordinary ballasts, ADVANCE KOOL KOIL Ballasts give 3½ to 4 times longer life.

"The Heart of the Lighting Industry."

ADVANCE TRANSFORMER CO.

World's Largest Exclusive Manufacturer of Fluorescent Lamp Ballasts

2950 NO. WESTERN AVE. CHICAGO 18, ILL. U.S.A.